

PB-231 251

UTILIZATION OF TRICKLING FILTERS FOR
DUAL TREATMENT OF DRY AND WET
WEATHER FLOWS

Peter Homack, et al

Elson T. Killam, Associates, Incorporated

Prepared for:

Environmental Protection Agency

September 1973

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**SELECTED WATER
RESOURCES ABSTRACTS
INPUT TRANSACTION FORM**

1. Report No. 2.

**PB 231 251
W**

4. Title
**Utilization of Trickling Filters for Dual Treatment
of Dry and Wet Weather Flows,**

5. Report Date **9/73**

6.

8. Performing Organization
Report No.

7. Author(s)

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9. Organization

**Elson T. Killam Associates, Inc.,
40 Essex Street
Milburn, New Jersey 07041**

10. Project No.
Project

EPA 11020 FAN

11. Contract/Grant No.

13. Type of Report and
Period Covered

12. Sponsoring Organization

Environmental Protection Agency-CRD

14. Availability Notes

**Environmental Protection Agency, Technology Series,
report number EPA-670/2-73-071, September 1973. 118p,
28 fig, 39 tab.**

A trickling filter sewage treatment plant was designed and constructed in the Borough of New Providence, New Jersey to alleviate local sewage treatment plant hydraulic overloading and resultant loss of treatment efficiency caused by excessive infiltration. The plant utilizes two high rate trickling filters, one with rock media, the other with plastic media, operating in parallel to treat wet weather flow. During dry weather periods the plant is operated in series with a controlled flow to maintain an active biological slime on the filters. The plant also consists of a primary clarifier-leveling reservoir, secondary clarifier and chlorine contact tank. No sludge handling facilities are provided.

A study of plant efficiency for one year indicated that during dry weather controlled flow operation, the BOD and suspended solids removal efficiency varied from 85 to 90 per cent. When operated during wet weather, the BOD and suspended solids removal efficiency varied from 56 to 74 per cent.

The plastic media trickling filter was found to remove more BOD per unit volume than the rock media trickling filter, under both dry and wet weather flow conditions.

This investigation has shown that it is both technically feasible and economical to design, construct and operate a treatment plant to process both the controlled dry weather flow and the higher flows encountered during periods of excessive infiltration using a combination of series-parallel high rate trickling filters. (EPA)

17a. Descriptors

***Waste water treatment
*Trickling Filtration, Rock, vs. Plastics Media Trickling Filtration,
Infiltration, Control, Dual Wet and Dry Weather Flow Treatment, Dual purpose,
Dry seasons, Wet seasons, *New Jersey, *Sewage treatment**

17b. Identifiers

***Dual treatment, New Providence, (NJ)**

17c. COWRR Field & Group

05D

18. Availability

19. Security Class.
(Report)

21. No. of
Pages

Send To:

20. Security Class.
(Page)

22. Price

**WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D. C. 20240**

Abstractor **Homack, Zippler, Herkert**

Institution

Elson T. Killam Associates, Inc.

Available from GPO Sup Doc
EP 1.23:6742-73 071, \$ 4.50
microfiche from NTIS as PB
\$1.45

September 1973

UTILIZATION OF TRICKLING FILTERS
FOR DUAL TREATMENT OF DRY AND WET WEATHER FLOWS

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EPA REVIEW NOTICE

This report has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

ABSTRACT

A trickling filter sewage treatment plant was designed and constructed in the Borough of New Providence, New Jersey to alleviate local sewage treatment plant hydraulic overloading and resultant loss of treatment efficiency caused by excessive infiltration. The plant utilizes two high rate trickling filters, one with rock media, the other with plastic media, operating in parallel to treat wet weather flow. During dry weather periods the plant is operated in series with a controlled flow to maintain an active biological slime on the filters. The plant also consists of a primary clarifier-leveling reservoir, secondary clarifier and chlorine contact tank. No sludge handling facilities are provided.

A study of plant efficiency for one year indicated that during dry weather controlled flow operation, the BOD and suspended solids removal efficiency varied from 85 to 90 per cent. When operated during wet weather, the BOD and suspended solids removal efficiency varied from 56 to 74 per cent.

The plastic media trickling filter was found to remove more BOD per unit volume than the rock media trickling filter, under both dry and wet weather flow conditions.

Significant nitrification occurred during the dry weather flow after ten months of operation. No significant nitrification occurred during wet weather operations.

Plant efficiency increased immediately after the resumption of dry weather flow following both short and long periods of wet weather or infiltration flow.

Limited testing showed that chemical flocculents did not increase suspended solids removal. This was attributed to the high overflow rates encountered in the secondary clarifier.

This investigation has shown that it is both technically feasible and economical to design, construct and operate a treatment plant to process both the controlled dry weather flow and the higher flows encountered during periods of excessive infiltration using a combination of series-parallel high rate trickling filters.

This report was submitted in fulfillment of Project Number 11020 FAN, under the sponsorship of the Office of Research and Monitoring, U. S. Environmental Protection Agency.

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SECTION I

CONCLUSIONS

1. The use of high rate trickling filters for the treatment of storm flow has been demonstrated to be an effective and economical approach for providing treatment to wet weather flows.

2. Dry weather treatment plant efficiency was found to increase more slowly than expected. During first year of plant operation, the average BOD and suspended solids removal efficiencies were found to be 86.2 and 87.0 per cent respectively. The final effluent BOD and suspended solids averaged 33 mg/l and 20 mg/l respectively.

After the first year, continued testing by plant personnel has revealed a dry weather flow BOD removal efficiency of 94 per cent and a suspended solids removal efficiency of 93 per cent. The corresponding concentrations of BOD and suspended solids in the final effluent are 9 mg/l and 12 mg/l respectively.

3. During wet weather flow periods the plant efficiencies were found to average 64.3 per cent for BOD removal and 67.9 per cent for suspended solids removal. The BOD in the final effluent averaged 39 mg/l and the suspended solids averaged 36 mg/l.

However, continued testing by plant personnel has indicated a BOD removal efficiency of 87 per cent and a suspended solids removal efficiency of 86 per cent in the final effluent. This is attributed to a reduction in the hydraulic and organic loadings in the plant which was achieved by pumping 1.5 MGD to the City of Summit during periods of excessive infiltration.

4. The plant efficiency promptly returns to normal levels immediately following the resumption of dry weather flow following both short and extended periods of wet weather flow.

5. The addition of alum and a polyelectrolyte (Dearborn 418) was not found to be effective in providing measurably increased solids removal to the treatment process during wet weather flow periods.

6. A drawback of the high rate trickling filter process for the treatment of high flows is the tendency for colloidal suspended material to be discharged from the filters. Unless chemical precipitation and low secondary clarifier overflow rates or supplemental biological flocculation in the form of a pond are provided, high suspended solids and BOD removal will not be obtained.

7. The plastic media trickling filter was found to remove about 2.7 times more BOD per 1000 ft³ than the rock media trickling filter. On a construction cost basis, the plastic media trickling filter costs \$1870 per pound of BOD removed per 1000 ft³, while the rock media trickling filter costs about \$3810 per pound of BOD removed per 1000 ft³, at a 45 per cent BOD removal efficiency. The initial construction cost of the rock media trickling filter was about 25 per cent less than the plastic media trickling filter for about one-third more volume. The greater removal efficiency attributable to the plastic filter may be due to its position as the lead filter during dry weather flow.

8. Hydraulic loading rates should be limited to 70 MGAD and organic loading rates limited to 85 pounds per 1000 ft³ on the plastic media filter and a hydraulic loading rate of 20 MGAD and an organic loading rate of 40 pounds per 1000 ft³ on the rock media filter to achieve an effluent containing 25 mg/l BOD or less during periods of excessive infiltration.

SECTION II

RECOMMENDATIONS

1. The average daily flow rate treated at the plant should be increased from the present 0.54 MGD to 0.70 MGD, or higher--particularly during the summer months when optimum trickling filter efficiencies generally prevail with increased temperatures. The treatment of additional flow during dry weather periods will have a beneficial effect upon the biological growth on the trickling filters and will result in higher plant efficiencies during wet weather flow periods.
2. The plant should be operated at a 2:1 flow split (twice the applied loading on the plastic media filter as compared to the rock media filter) during wet weather flow periods because of the greater ability of the plastic media filter for the removal of BOD.
3. An additional secondary clarifier or pond should be installed to provide lower hydraulic overflow rates and therefore increase suspended solids removal. Future designs of this type should make liberal allowances for the hydraulic overflow rates occurring during storm flows.
4. Under routine plant operations in the future, the pumps which discharge into the City of Summit system should be kept in operation during storm flow periods. This will reduce the storm flow passed through the plant by an average of 1.5 MGD and should result in improved plant performance during wet weather periods.
5. Due to the impact this unique plant may have on the combined sewer overflow field, further studies should be conducted at this plant to determine the following:
 - a) The effect of passing more flow through the plant in dry weather and its effect on wet weather operation.
 - b) The optimum loading at which nitrification can proceed.
 - c) Whether two-stage high rate trickling filters can give 90-95 per cent BOD removal consistently during dry weather and at what loadings this can be accomplished.
 - d) What factors cause nitrification to cease during storm flow and immediately return when the hydraulic rates are reduced during dry weather flow.

- e) What mechanism is responsible for the rapid return to high efficiency BOD removal when the treatment plant returns from wet weather to dry weather flow rate.
- f) A comparison of filter efficiencies if the rock media trickling filter instead of the plastic media trickling filter is the lead filter during dry weather flow.

SECTION III

INTRODUCTION

Many communities throughout the country have sanitary sewer systems which are subject to large amounts of infiltration. The resultant high flows due to this infiltration cause hydraulic overloads at sewage treatment plants, resulting in the discharge of a poorly treated effluent. In addition, sanitary sewer systems are subject to surcharge conditions often resulting in raw sewage popping out of street manholes and backing up into basements.

This report deals with the investigation of a treatment plant designed to adequately treat these high flows due to the excessive infiltration.

Objectives

The objectives of this study were to (a) establish the practicability and economic feasibility of utilizing a plastic media trickling filter and a trap rock media filter for treatment of storm water flows, (b) determine the filter efficiencies at various hydraulic loading rates under storm flow conditions, (c) determine the point at which the filters fail due to a high applied hydraulic loading during storm flows and (d) develop a plan of operation to further improve the effluent quality.

The Community

The Borough of New Providence is located in Union County, New Jersey (See Figure 1). The community is essentially residential, but has some limited, light industry and corporate research facilities. The population of the community is 15,000 persons. The Borough is totally sewered. However, the sanitary sewer system acts as a combined sewer system during heavy rainfall. The infiltration which gains access to the system is mainly a result of the leaky joints in the vitrified clay tile collection system.

The entire watershed of the Borough is tributary to the Passaic River. The Passaic River is a major source of water supply for Northern New Jersey. Water is withdrawn from the river immediately downstream from the Borough wastewater treatment plant and utilized for potable water supply purposes by the Commonwealth Water Company and further downstream by the Passaic Valley Water Commission at Little Falls, New Jersey.

Early in 1964, a study was undertaken to determine the feasibility of reducing storm water infiltration into the Borough of New Providence



FIGURE 1

TOPOGRAPHICAL MAP AND RAIN GAUGE LOCATION

(BASF MAP FROM U.S.G.S. TOPOGRAPHICAL MAPS)

sanitary sewer collection system. The results of this study revealed that the collection system in the Borough, which had first been installed in 1938, was constructed of vitrified clay tile pipe with poured tar joints. Subsequent construction in 1950, and thereafter, was undertaken utilizing cement-asbestos sewer pipe. House connections consisted of 4-inch diameter cast iron pipe with jute and lead joints. The entire collection system consists of approximately 216,000 feet of pipe, or about 41 miles. It was found that the collection system suffered from infiltration during periods of rainfall in amounts far greater than might normally be expected in a strictly "sanitary" sewer collection system. Table 1 is a record of the average daily flow, rainfall and house connections to the system since 1960.

Existing Disposal System

The facilities for the disposal of sewage, originally built in 1937 and modified in 1953 (Figure 2), consisted of a pumping station to convey the raw sewage to the City of Summit sanitary sewer system for delivery to the Elizabeth Joint Meeting regional system for treatment. A primary settling tank and chlorination facilities were provided to treat the flow during periods of heavy rainfall in excess of the pumping station capacity of approximately 1.5 MGD.

The Borough of New Providence has capacity rights for the discharge of an average of 1.5 MGD (not more than 0.5 MG during any eight-hour period) of sewage into the City of Summit sanitary sewer system. An average of about 1.5 MGD was pumped into the City of Summit system, and storm water flows in excess of this amount were treated in the primary treatment facilities and discharged into the Passaic River following chlorination.

While these facilities were initially considered adequate to process peak flows of approximately 0.3 MGD, they became grossly inadequate with the growth of the system. As State discharge requirements became more stringent, an alternative solution had to be found to treat the ever-increasing amounts of dry and wet weather flow.

To adequately treat the excessive amount of infiltration, a treatment plant was designed to provide biological treatment utilizing trickling filters. It became apparent that, in order to maintain an active biological slime to treat excessive wet weather flows, the application of a controlled dry weather flow was required. A highly flexible treatment plant was necessary in which series filtration would be provided for the low, controlled dry weather flow. The low flow and resultant lower organic loads applied would provide a very high quality effluent. During wet weather, the plant would automatically change to parallel filtration. A variable hydraulic load could be placed on each filter to achieve maximum organic removals.

TABLE 1
FLOW COMPARISON WITH PREVIOUS YEARS

	<u>Average Daily Flow (MGD)</u>	<u>House Connections</u>	<u>Precipitation (Ins.)</u>
1960	1.05	2,489	50.73
1961	1.14	2,653	44.58
1962	1.26	2,822	47.98
1963	1.35	2,940	37.92
1964	1.54	3,008	39.52
1965	1.38	3,050	34.38
1966	1.43	3,107	45.97
1967	1.86	3,166	52.09
1968	1.87	3,220	46.67
1969	1.90	3,283	52.35
1970	2.03*	3,330	39.89
1971	2.06	3,347	62.59

*Average daily flow was computed from January through May in 1970, after which the raw sewage meter was inoperable for the balance of the year due to the construction of the new plant.

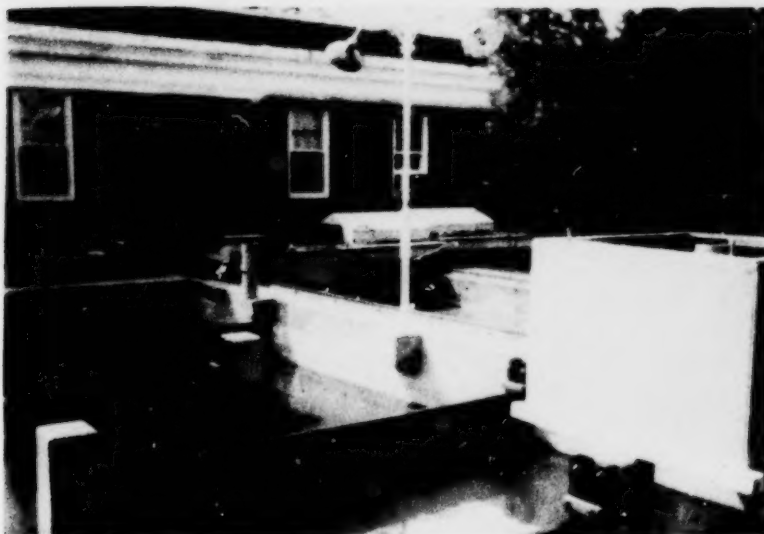


FIGURE 2

CHLORINE CONTACT TANK AND PRIMARY CLARIFIER BEFORE EXPANSION

A grant offer was made and accepted by the Borough of New Providence on May 24, 1967, from the Federal Water Pollution Control Administration (now the Environmental Protection Agency), to demonstrate the economic feasibility of the biological treatment of excessive flows due to infiltration utilizing trickling filters. Bids were received on March 3, 1969, for a total construction cost of \$1,005,023.50. A breakdown of this cost is presented in Table 2. The low bidder started construction in May, 1969, and completed the work by early December of 1970. The wastewater treatment plant was placed in operation on December 22, 1970.

TABLE 2
BOROUGH OF NEW PROVIDENCE
COST OF STORM WATER TREATMENT PLANT FACILITIES

<u>Item No.</u>	<u>Description</u>	<u>Construction Cost</u>
1	Renovations and Additional equipment in Existing Pump- ing Station	67,365.00
2	Primary Clarifier-Leveling Reservoir	135,823.00
3	Plastic Media Trickling Filter	100,993.00
4	Rock Media Trickling Filter	76,243.00
5	Final Clarifier and Recircula- tion Pump Station	104,980.50
6	Chlorine Contact Tank	48,849.00
7	New Administration Pump Build- ing and Equipment	224,282.00
8	Site Piping	110,576.00
9	Site Construction Works	66,111.00
10	Chemical Feed Equipment, Pip- ing and Appurtenances	7,705.00
11	For Furnishing and Installing Electrical Equipment	51,158.00
12	For Furnishing and Installing Heating and Ventilating Equipment	10,938.00
Total Construction Cost		\$1,005,023.50

SECTION IV

DESIGN FEATURES OF THE WASTEWATER TREATMENT PLANT

The wastewater treatment plant was designed to process a very wide range of flows at extremely high applied hydraulic loadings. During dry weather flow conditions, a controlled low flow was applied to the filters to maintain an active biota. Thus, under various seasonal (climatic) conditions, the treatment plant could then process the extremely variable quantity of wet weather or storm water flow.

Other alternatives were considered to treat the large quantity of infiltration experienced; namely, (1) the storage of all storm flows in the vicinity of the treatment plant, followed by treatment at a uniform low rate after the flows had returned to normal; and (2) storage and pumping into the City of Summit system for transmittal to the Elizabeth Joint Meeting system following the resumption of dry weather flow conditions. Both alternatives were rejected due to the limited land area of the site which did not allow space for the construction of ponds to store the expected volume and the problems associated with maintaining the solids deposited in the pond in a nuisance-free state.

Replacement of the sewer system was rejected as being too costly. The replacement cost for the collection system had been estimated to be approximately \$8 million, and no assurance could be given that the wet weather flows would be significantly and permanently reduced to avoid special treatment of the wet weather flows.

The following criteria governed the plant design:

- a. Sufficient flexibility to process wet weather flow variations of from four to six times the average daily dry weather flow, or from ten to fifteen times the average flow proposed to be treated at this plant under controlled, uniform dry weather flow conditions.
- b. Utilize all of the available "rights" for the discharge of an average daily flow of 1.5 MGD to the City of Summit system, with the limitation that no more than 0.5 MG be discharged in any eight-hour period.
- c. Provide a treatment process which would be simple and economical to operate.

- d. Meet the State objectives for treatment under dry weather flow conditions and provide a high degree of treatment under wet weather or storm flow conditions.

A high rate trickling filter plant was designed to meet the above criteria. The plant was provided with two trickling filters which are operated in series or parallel, depending on the flow. A low constant flow was applied during dry weather conditions. This provided an active biota so that when wet weather flows occurred, parallel operation of the filters would be possible. Both a plastic media filter and a trap rock media filter were included.

Description of Treatment Plant

The treatment plant consists of comminution, pumping, primary sedimentation, primary and secondary bio-filters with pumped recirculation, final sedimentation and chlorination. The Pump Station-Administration Building-Laboratory houses facilities for pumping sewage to the City of Summit, second stage pumps, transfer pumps, seal water pumps, chlorination, instrumentation, power distribution and laboratory control.

The treatment facilities were constructed on a site consisting of approximately 1.5 acres.

Inlet Facilities

Inlet facilities are located within the original plant building which houses the raw sewage pumps. Two comminutors are provided for shredding the coarser solids contained in the raw sewage. The comminuting device is a mechanically cleaned screen, which incorporates a cutting mechanism that shreds the retained material without removal from the sewage flow. The comminutor is a hydraulically-driven unit consisting of a stationary semicircular stainless steel screen, in replacement sections, and hardened stainless steel stationary and oscillating cutters. The cutters shear the coarse material to a size which can pass through the slots of the screen. The one piece cutter bars are adjustable and readily removable for sharpening or replacement. A gravel trap is provided in front of the comminutor units to protect the units from damage. The capacity of each of the two comminutors is 3.5 MGD. Neither comminutor was installed under this construction contract.

Immediately downstream of the comminutors is a 9-inch Parshall flume with an indicating and recording chart to record the total raw sewage flow into the treatment facility.

Existing Pumping Station

Three new low lift raw sewage pumps have been installed in the existing pumping station. Each of these pumps has been designed to handle a maximum wastewater flow of 4.0 MGD. Each pump is driven through a wound rotor variable speed motor. The pumping system has been designed so that one unit is on standby while the other two pumps are active. With only two pumps in service, the pumping station capacity is approximately 8 MGD. This will handle practically all peak flow rates at the treatment plant without utilizing the standby pump. Located within the existing pumping station are series high lift pumps which are used to pump the raw sewage from the wet well through a force main into the City of Summit system. These pumps are variable speed and are controlled through a Flomatch unit. With the installation of the new pumping facilities, these pumps have now become standby units to the single stage high lift Summit pump which has been provided in the new Pump Station-Administration Building. The series pump capacity is approximately 1.5 MGD. The installation of the new pumps and pumping facilities has resulted in a marked reduction in backflooding and surcharging in the Borough collection system. Even during the storm flow of hurricane Doria (1971), no basement flooding was reported in the Borough.

Primary Clarifier-Leveling Reservoir

Raw sewage is pumped by the low lift pumps into the new primary clarifier-leveling reservoir which provides the first phase of treatment for the entire flow which is tributary to the New Providence pumping station. The primary clarifier-leveling reservoir has a two-fold function:

1. During both dry and wet weather flow periods, the unit removes organic material, as well as scum and other floating materials.
2. During dry weather periods, the large volume of the tank, namely, 425,000 gallons, provides a detention time of approximately 6.8 hours at 1.5 MGD, thereby providing "equalization" storage which permits the storage of daytime peak flows so that uniform continuous pumping into the City of Summit system over a 24-hour period is possible. The pumping of sewage into Summit is possible at a constant rate of about 1.5 MGD, which comprises the "rights" for discharge into their system. The large volume of the primary clarifier unit permits a means of leveling out the raw sewage flow into the plant.

The sludge which accumulates at the bottom of the settling tank is pumped into the City of Summit system. This operation is conducted daily over an operating period of about three hours.

Plastic Media Trickling Filter

During periods of dry weather flow operation, a controlled volume of primary treated effluent is applied to the surface of a 36' diameter by 14.4' deep plastic media trickling filter. The primary tank effluent consists of an average of about 0.3 to 0.4 MGD, which is pumped constantly with a transfer pump, plus any sewage which overflows the weirs of the primary clarifier during the peak flow period each day. The primary tank effluent is combined with 0.8 MGD of recirculated flow from the secondary clarifier.

During wet weather flow periods, a variable amount of primary settled effluent is applied to the plastic media filter. The remainder is applied directly to the rock trickling filter.

The application of the combined primary tank effluent and recirculated flow onto the trickling filter is accomplished by means of a pair of trickling filter arms which rotate by virtue of the liquid head created in the center column, to which the rotating arms are attached.

The base of the plastic media trickling filter consists of an aluminum grating placed across the bottom which is supported on beams connected to the concrete walls. Twenty-eight adjustable air vents are provided at the base of the system to control the air supply to the filter.

Trap Rock Media Trickling Filter

During dry weather operation, the effluent from the plastic media filter is pumped by two second-stage pumps to the high rate rock trickling filter. The rock trickling filter is 65 feet in diameter, has a stone depth of 6' and is constructed of concrete.

During wet weather operation, a variable amount of primary settled effluent is applied directly to the rock filter and the balance to the plastic filter which is operating in parallel. The combined effluents flow directly to the final clarifier.

The base of the rock trickling filter consists of filter blocks placed across the entire surface area. These blocks are slotted at the top and contain tiers of semicircular channels in their base. Flow from the filter enters the tops of the slotted filter blocks and passes along the block channels and is collected in a channel which runs the full length of the trickling filter. At either end of the concrete channels, inspection chambers are provided. The chamber located at the upstream end is used for inspection, and the chamber at the downstream end is used to house the sluice gates for back-flushing or flooding the filter, and also as an outlet control to the final clarifier. Additionally, these manholes aid in the passage of air to the

filter media.

Final Clarifier

The final clarifier is 70' in diameter with an 8' side water depth. Bottom sludge scraper facilities are provided. The arms operate at about 2.0 revolutions per hour. With a storm flow of 3 MGD, the overflow rate is 780 gpd/ft², and a detention time of 1.85 hours is provided.

The recirculation pumps have a capacity of about 0.8 MGD. These are utilized during dry weather flow periods in order to provide the minimum hydraulic loading for the trickling filters and to provide a reasonable recirculation ratio. A recirculation launder has been provided in the final clarifier. The sludge from the bottom of the final clarifier flows, by gravity, to the inlet of the plant.

Chlorine Contact Tank

All of the treated plant effluent is chlorinated in the chlorine contact tanks. Each of the two tanks is 50' long and 12½' wide with a side water depth of 6 feet.

Chlorine is added at the chlorine manhole, which is located just downstream of the final clarifier and ahead of the chlorine contact tank.

Since the chlorine contact tank consists of two separate tanks, provisions are made for the cleaning of one tank, while the other tank is retained in service. One chlorine contact tank has been provided with "around the end baffles" and the other with "under and over baffles".

Figure 3 illustrates the system process piping and the relative location of the units on the site.

Figure 4 shows the process flow in series (dry weather) flow and in parallel (wet weather) flow operation. A hydraulic profile is also shown on this figure.

Table 3 summarizes the design data for the plant.

Equipment and Suppliers

The following major items of equipment were supplied for this plant:

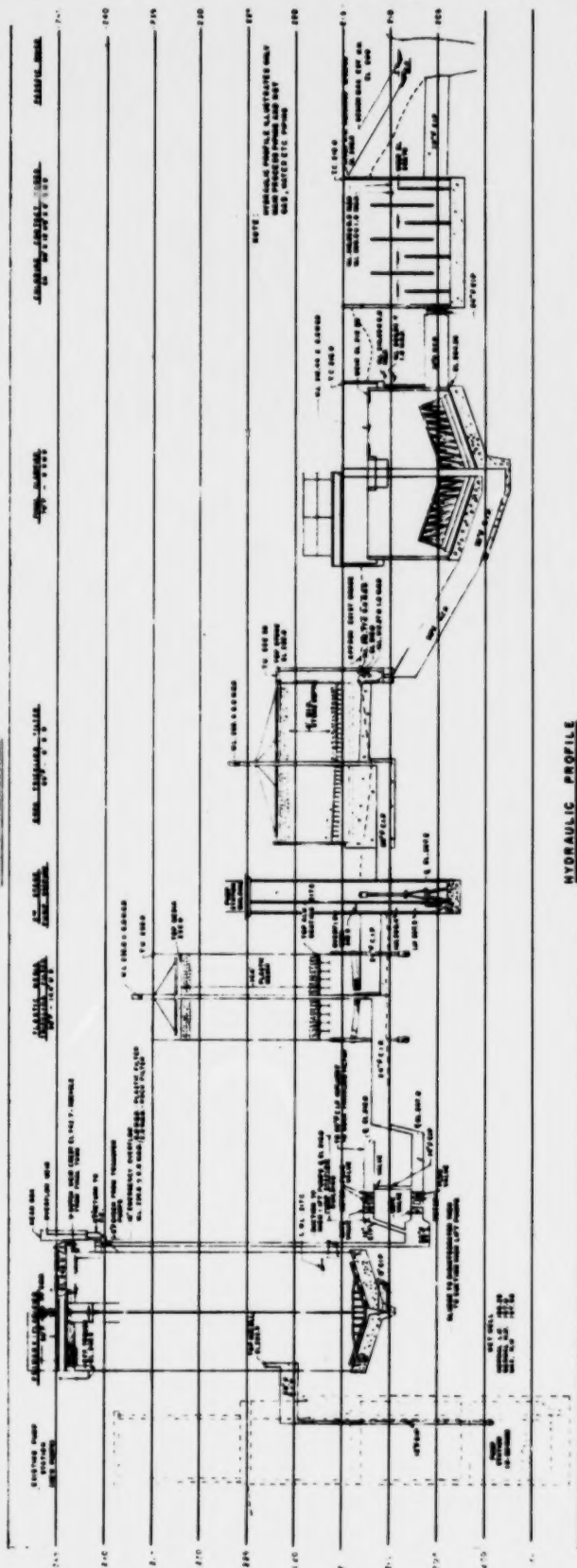
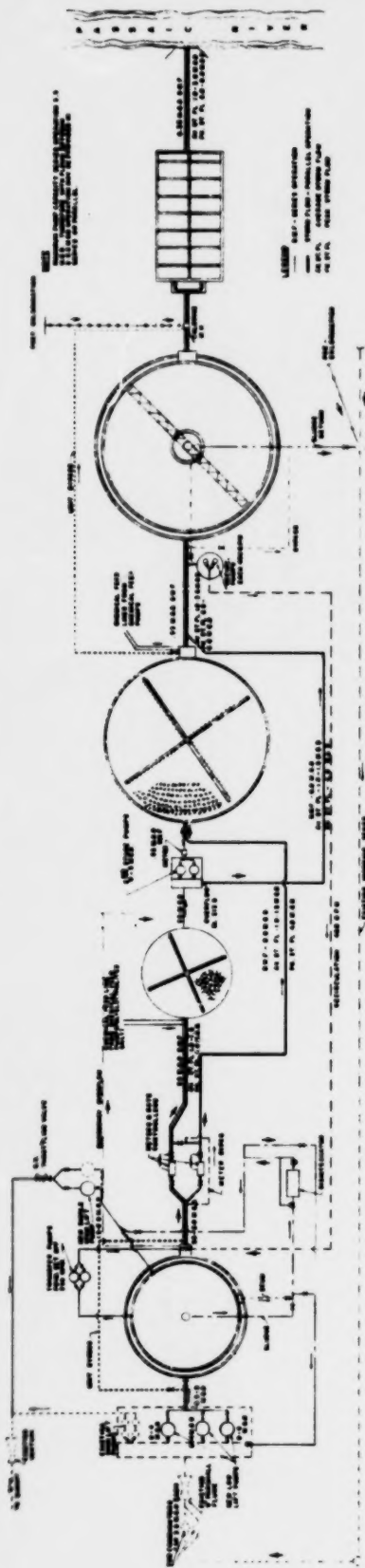


FIGURE 4
FLOW DIAGRAM AND HYDRAULIC PROFILE

TABLE 3

FINAL DESIGN DATA						
Description	Recirc.	BOD Loading (lbs)	Plastic Media (2) Trickling Filter	Rock Trickling Filter	Secondary Clarifier	Chlorine Contact (2 Units)
Proposed Unit Dimensions	-	-	36' dia x 14.4' Media Depth	65' dia - 6' Stone Depth	70' dia x 8' SWD	Each 50' long x 12 1/2' wide x 6' deep
Area (Sq. Ft.)	-	-	1020	3300	Clarifier 3850	
Volume (Cubic Feet)	-	-	14,800	19,800	Clarifier 30,600	7,500 (Total)
Average D.W.F. (.35 mgd)*	.58 mgd	400-600***	SERIES OPERATION Hydraulic Loading-gpm/ft ² or (MGAD) 0.65 or (40) 0.195 or (12.2) Biological Loading-lbs/1000 ft ³ (1) 27 → 40 1/2 10 → 15 (Raw Only) (Raw Only) PARALLEL OPERATION (EQUAL SPLIT) Hydraulic Loading-gpm/ft ² or (MGAD) 0.64 1.0 or (40 62) 0.195 .32 or (12.2 20) Biological Loading-lbs/1000 ft ³ (1) 40 1/2 → 51 30 1/2 → 38 Hydraulic Loading-gpm/ft ² or (MGAD) 2.05 or (125) 0.63 or (39 1/2) Biological Loading-lbs/1000 ft ³ (1) 118 88			
Average Storm Flow Conditions (1-3.0 mgd)	As Required				0.R.-92 gpd/ft ² does not include recirculation	Detention Time 3.8 Hrs.
Peak Storm Rate** (6.0 mgd)	None	1200-1500 ***			0.R. - 260 780 pd/ft ² Detn. 5.5 1.85 hrs.	Detention 1.33 hrs. 26 1/2 mins.
		3500(Rate) ***			0.R. 1560 gpd/ft ² Detn. .93 hrs.	Detention 13 mins.

*Minimum Applied Rate to Filters - .93 mgd. (1) Assumes no reduction in primary clarifier.

**Might only occur for a 1 to 2 hour period. (Does not include 1.5 mgd being pumped to Summit).

***Estimated - to be verified by further testing. (2) Lead filter dry weather

Pumps and Motors

<u>Pump</u>	<u>Manufacturer</u>	<u>Capacity</u>	<u>Motor</u>	<u>Size</u>
Main Sewage Low Lift No. 1, 2 and 3	Fairbanks-Morse	2900 GPM 62' TDH	Continental	60 HP
High Lift	Allis-Chalmers	1050 GPM 220 TDH	Allis-Chalmers	200 HP
Sludge Grinder	Dorr-Oliver	4 x 6 Gorator	U. S.	25 HP
Transfer 1 and 2	Fairbanks-Morse	250 GPM 30' TDH	Continental	3 HP
Second Stage 1 and 2	Allis-Chalmers	2100 GPM 22' TDH	Continental	15 HP
Recirculation 1 and 2	Yeomans	400 GPM 37' TDH	Marathon	7½ HP
Seal Water 1 and 2	Aurora	15 GPM 70 TDH	Aurora	3/4 HP
Chemical Feed	Hills-McCanna	239 GPH 40 psi	Louis Allen	1 HP

Miscellaneous Equipment

<u>Item</u>	<u>Manufacturer</u>	<u>Model or Capacity</u>
Chemical Mixers	Lightnin	ND-1A
Chemical Mixers	Lightnin	NC-4
Chlorination Equipment No. 1	Fischer Porter	20-400 lb.
Chlorination Equipment No. 2	Fischer Porter	15-300 lb.
Scale	Howe-Richardson	4400 lbs.
Primary Clarifier Mechanism	Dorr-Oliver	Type A
Final Clarifier Mechanism	Walker Process	Type RS

Miscellaneous Equipment
(Continued)

<u>Item</u>	<u>Manufacturer</u>	<u>Model or Capacity</u>
Trickling Filter Distributor Rock Media	Dorr-Oliver	Type KCB
Plastic Media	Dorr-Oliver	Type KCB
Air Compressor 1 and 2	Ingersoll Rand	57 TXS-57 TDS
Boiler	H. B. Smith	G-12 Sulta
Hot water Heater	A. O. Smith	Pen-40

Operation of Trickling Filters During Controlled Dry
Weather Flow Conditions

During dry weather flow periods, the two trickling filters are operated in series. The plastic media trickling filter is operated as the lead filter, and the rock media trickling filter is operated as the second filter.

The flow to the plastic media trickling filter is made up of the primary settled effluent being withdrawn by the transfer pump at a constant rate, the overflow—if any—from the primary clarifier, and the recirculation flow from the secondary clarifier. The sum of the transfer (namely 0.3 - 0.4 MGD) and recirculation flows (namely 0.8 MGD) average approximately 1.2 MGD when there is no overflow from the primary clarifier.

When the total flow to the plastic media trickling filter is less than 2.8 MGD, the effluent from the plastic media filter will flow to the second stage wet well whereupon it is pumped by one of two second-stage variable speed pumps to the rock media trickling filter. Each pump has a maximum capacity of 3 MGD. All flows are continuously recorded and totalized on an instrument panel in the Administration Building.

Operation of the Trickling Filters During Wet Weather Flow Conditions

During the period of testing, it was desired to apply the maximum possible storm flow through the plant. Accordingly, the pumps to the City of Summit were not normally kept in operation during the storms

and practically all of the raw sewage flow was put through the plant.

When the total flow to the first stage plastic media filter exceeds 2.8 MGD, the plant operation is automatically transferred to the parallel mode of filter operation. A portion of the total filter flow is then conveyed to the plastic media filter and the remainder to the rock trickling filter. The effluents from the two filters are combined and conveyed to the final clarifier. When in parallel operation, the second stage and recirculation pumps are automatically turned off.

The flow to each filter can be varied, either on a preset ratio basis or a preset constant flow basis. These operations can be controlled as follows: An adjustable preset constant flow to the plastic filter can be maintained automatically by the control circuit. Under this mode of operation, a constant flow is applied to the plastic media trickling filter with any excess flow discharged onto the rock media trickling filter. Similarly, an adjustable preset constant flow can be maintained to the rock media trickling filter with any excess flow applied to the plastic media trickling filter. In addition, a constant ratio of flow can be maintained between the plastic media trickling filter and the rock media trickling filter. This ratio can be set between 0.2 and 4.0, i.e., if the indicator is set at 1.0, it would indicate that both filters--the plastic and the rock--would be receiving the same flow. If the total filter flow exceeds 4.5 MGD, the raw sewage pumps which pump to Summit at a constant rate of 1.5 MGD are automatically turned off. When the wet weather flow decreases to 3 MGD, the Summit pumps are automatically turned back on. At a flow rate of 2 MGD, the secondary treatment system will switch automatically from parallel to series operation, which results in the turning on of the second stage and recirculation pumps.

Under the foregoing conditions, an extreme amount of flexibility is provided in the operation of the plant for the treatment of both dry weather and wet weather flows.

SECTION V

UNUSUAL ASPECTS OF CONSTRUCTION

During the construction of these facilities, several changes or modifications were required. In addition, when the plant was placed in service, some operational difficulties were encountered and modifications were required to some of the units.

Three problems were encountered prior to and after the construction of the primary clarifier leveling reservoir:

1. A deeper excavation was required than originally anticipated because of the subsurface conditions encountered. This required the placement of compacted fill. The new tank was constructed in an area occupied by existing structures which were abandoned and demolished during plant construction. The additional excavation was about 5' deep under about 95 per cent of the tank area and about 18' deep under about 5 per cent of the tank area.

In addition to the deeper excavation due to unsuitable conditions, it was found that the piers supporting the existing tanks were deeper than shown on available record drawings and these piers had to be removed. Compacted backfill was installed in layers utilizing vibratory compactors. Based on subsequent surveys, it has been determined that no settlement of the primary clarifier has taken place.

2. Excessive upward currents were formed in the primary clarifier, due to the vertical 90 degree long radius elbow on the clarifier inlet, resulting in the passage of floating material over the "V" notch weir. The installation of a horizontal baffle plate 1' above the 90 degree elbow was successful in deflecting and dissipating the excessive vertical currents, and the clarifier then functioned normally.

After the primary clarifier leveling reservoir had been in operation for some time, it was found that scum and other floatable materials were being discharged past the scum baffle and were clogging the rock and plastic media trickling filter. This problem was solved by the installation of a "U" shaped trough attached to the tank wall and extending beyond the scum baffle which kept the lower part of the

baffle submerged at all times, thereby retaining the scum and other floating materials on the water surface within the scum baffle. These materials are then removed by the skimming mechanism. Four 1-inch diameter drain valves were installed in the trough for dewatering purposes when necessary.

3. Another area requiring alteration was the instrument air system in the Pumping Station-Administration Building. The system was designed and installed with a coalescing filter with an automatic trap on the discharge piping of the air receiver, which also had an automatic condensate trap. During startup stages, moisture remained in the air piping system, thus affecting the individual airpak filter-regulators at each of the automatic plug valves in the system. During this time, the coalescing filter and automatic condensate trap on the air receiver were working properly but could not handle all of the moisture contained in the air system. The problem was resolved by installing a refrigerated compressed air dryer on the discharge piping of the air receiver before the coalescing filter. The dryer removes all of the moisture from the air system and maintains the airpak filter regulators free from moisture and also protects all other devices in the system.

After a period of extended use, other problems were encountered in two units of equipment. The first problem was in the rock trickling filter magnetic flow meter which was not generally in use and, subsequently, was not kept completely filled with liquid. As a result, "false" signals were sent to the recorder, causing the instrument panel to operate improperly. Specifically, the filter operation would be changed from series to parallel operation without the required increase in flow to warrant this change in operation. This was corrected by installing a relay in the instrument panel to eliminate electrical power to the flow meter; thus eliminating the "false" readings when the meter received no flow. The power is restored to the meter when the system switches to parallel operation.

Another unit which required field adjustment and alteration was the sludge grinder installed on the sludge withdrawal line from the primary clarifier leveling reservoir. It was found that the openings between the cutter bars in the unit were too small and that these would eventually clog, thus causing the pump to overheat. This eventually caused extreme wear on the cutter bars and rotating plate. The equipment manufacturer supplied a new type of cutter bar, developed after

the unit was installed, which provided a means to select the size of opening between the cutter bars as required by the material being shredded. This eliminated the problem of having too small an opening and reduced the resultant wear on the cutter bars and rotating plate.

The following photographs (Figures 5 to 13) were taken during and after construction of the facility:



FIGURE 5
START OF CONSTRUCTION ON FINAL CLARIFIER

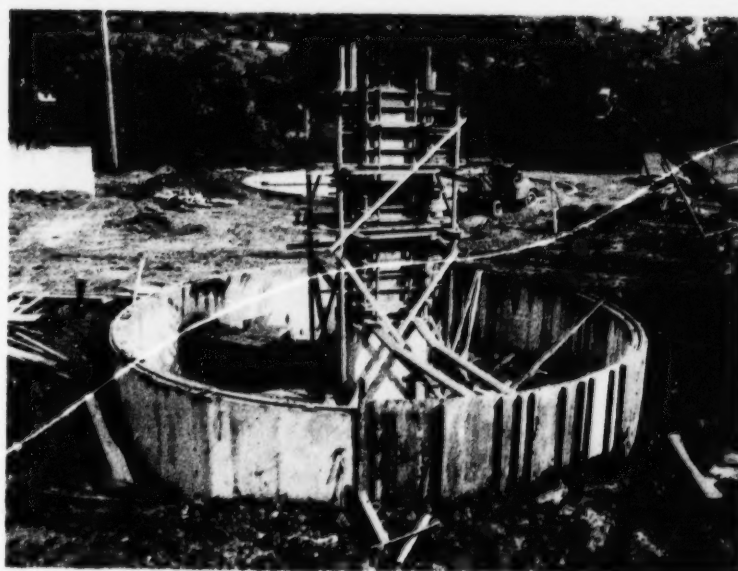


FIGURE 6
FOUNDATION FOR PLASTIC MEDIA TRICKLING FILTER



FIGURE 7
CONSTRUCTION PROGRESS ON CONTROL BUILDING, PLASTIC MEDIA FILTER,
ROCK FILTER AND SECONDARY CLARIFIER

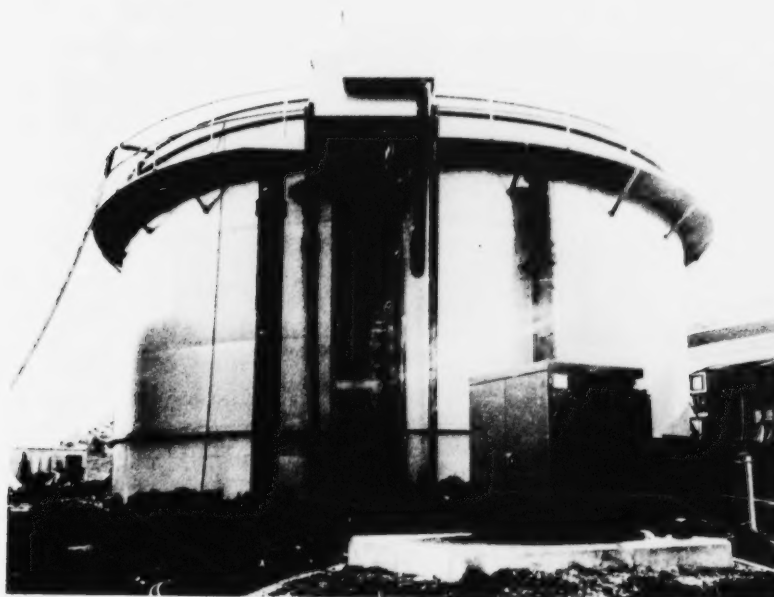


FIGURE 8
PRIMARY CLARIFIER - LEVELING RESERVOIR NEAR COMPLETION



FIGURE 9
CONSTRUCTION ALMOST COMPLETED ON PRIMARY CLARIFIER-LEVELING
RESERVOIR, PLASTIC MEDIA TRICKLING FILTER AND SECONDARY
CLARIFIER.



FIGURE 10
PLASTIC MEDIA TRICKLING FILTER IN FOREGROUND. ROCK MEDIA
TRICKLING FILTER AND SECONDARY CLARIFIER IN BACKGROUND.

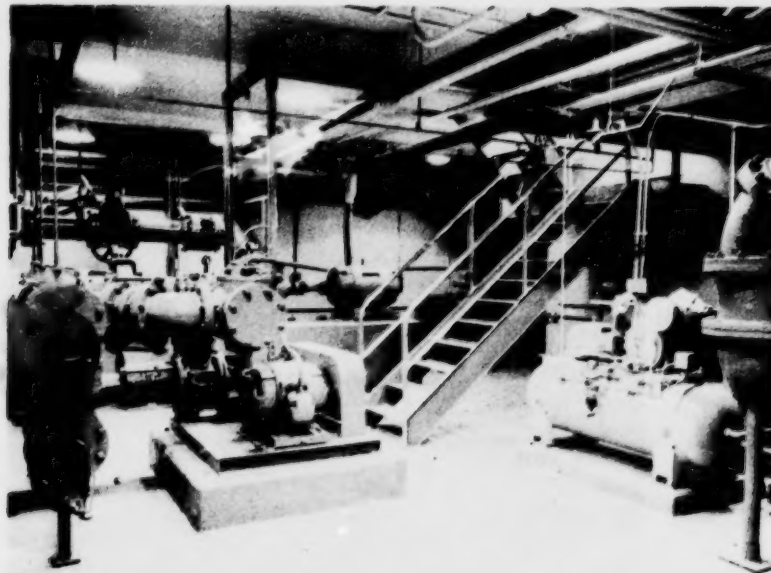


FIGURE 11
PUMPING STATION IN BASEMENT OF ADMINISTRATION BUILDING



FIGURE 12
COMPLETED SITE VIEW SHOWING SECONDARY CLARIFIER, PLASTIC MEDIA
TRICKLING FILTER, ADMINISTRATION BUILDING AND PRIMARY CLARIFIER
- LEVELING RESERVOIR.



FIGURE 13
AERIAL VIEW OF COMPLETED TREATMENT PLANT.

SECTION VI

RESULTS AND DISCUSSION

Sampling and Analysis

During this study, the following sample locations were used:

- a. Raw sewage - upstream of Parshall flume
- b. Primary clarifier effluent
- c. Plastic media trickling filter effluent
- d. Rock media trickling filter effluent
- e. Secondary clarifier effluent

The following samplers were employed:

- a. Raw sewage - N-Con Systems, Inc. -
"Surveyor" Sampler
- b. Primary clarifier effluent - N-Con Systems, Inc. -
"Sentry" Sampler 24 Hour Sequential Sampler
- c. Plastic media trickling filter - Manual
- d. Rock media trickling filter - N-Con Systems, Inc. -
"Surveyor" Sampler
- e. Secondary clarifier effluent - Lea Recorder LTD.
Manchester, England; 24 Hour Sequential Sampler

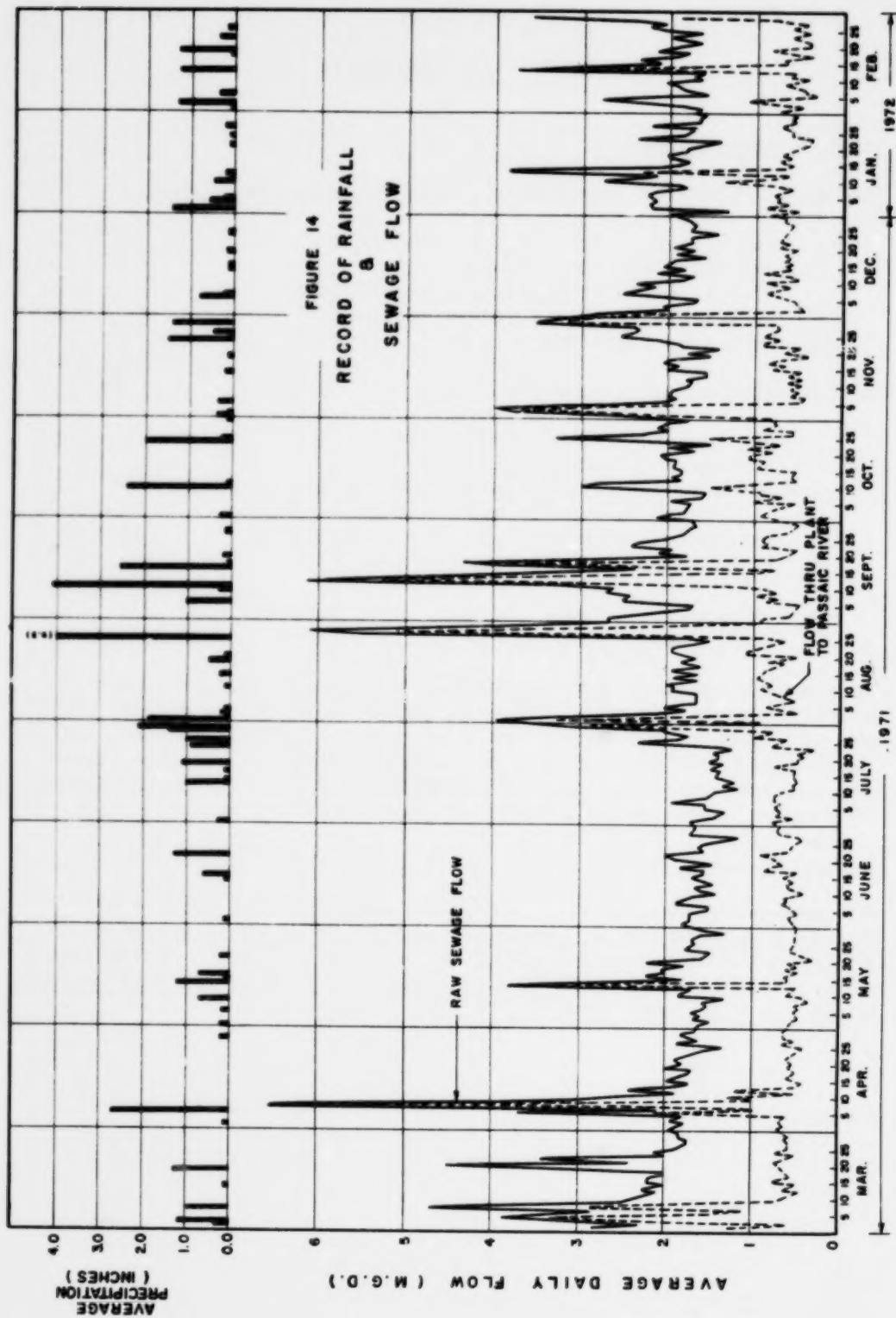
The samplers employed gave generally trouble-free operation with the exception of the sequential 24-hour sampler used on the primary effluent. The lack of reliability of this sampler required constant checking to insure the samples were collected. During cold weather when temperatures were at or near freezing, light bulbs were placed inside the sampler enclosure to prevent the sampler from freezing.

Methods of Analysis

All samples were analyzed in accordance with the 13th Edition of "Standard Methods for the Examination of Water and Wastewater" with the exception of phosphorus which was analyzed according to the procedure as outlined in the "FWPCA Methods for Chemical Analysis of Water and Wastes - November 1969."

Flow

Figure 14 is a plot of the total daily raw sewage flow as metered at the inlet of the plant and the volume of flow treated daily at the plant and discharged following treatment into the Passaic River.



This plate also shows the measured precipitation for the study period. The difference between the total flow entering the treatment plant and the flow which is treated and discharged into the Passaic River represents the daily flow which was pumped into the City of Summit system.

Table 4 is a summary of this data by months.

Appendix A contains the tables which show the daily raw sewage flow, daily flow pumped to Summit, daily flow which was treated and discharged into the Passaic River, daily precipitation and the daily flow in the Passaic River during this entire study period.

From 1963 until 1967, a severe drought occurred. The next four years average precipitation fell. 1971 is characterized as a wet year.

The average daily sewage flow in the Borough of New Providence system during this study period was 2.06 MGD. An average of 1.16 MGD was pumped to the City of Summit system, and an average of 0.90 MGD was discharged into the Passaic River following treatment.

It is interesting to note that approximately 100 per cent of the wet weather or storm flow was passed through the treatment plant during the storm episodes and was discharged into the Passaic River. This wet weather or storm water flow amounted to approximately 108 MG, or approximately 33 per cent of the total Borough of New Providence flow which was treated through the plant during the study period. This clearly illustrates the importance of properly treating the increase in flows during wet weather. Of course, the study period contained exceptionally heavy rainfall, and the sewage flow during periods of normal rainfall may be somewhat less.

The Passaic River flow is also plotted for this study period in Figure 15. The river flow records show that the flow varied from a peak of 2030 cfs, or 1,318 MGD on August 30 to a low flow of 13 cfs, or only 8.4 MGD on August 25. The mean river flow for 1971 was approximately 243 cfs, or 157 MGD.

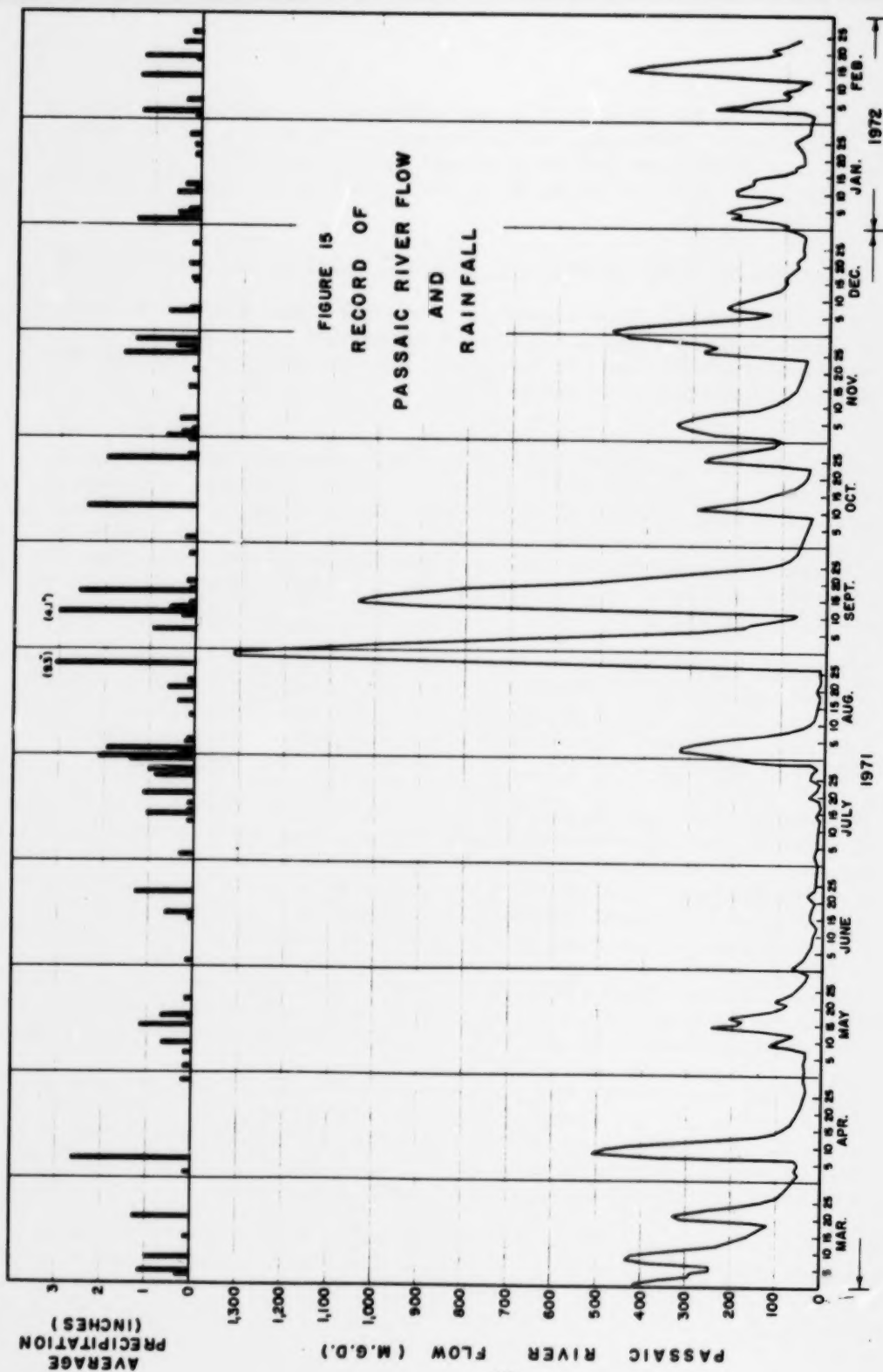
Preliminary Investigation

Late in December of 1970, the treatment plant was completed and placed in routine operation. The trickling filter units were studied to determine whether sufficient biological growth had accumulated to support an efficient biological treatment process. The preliminary studies indicated toxicity in the BOD determination and, as a result, a further investigation was undertaken which determined the presence of hexavalent chromium in the incoming raw sewage due to an industrial waste which was discharged into the Borough of New Providence collec-

TABLE NO. 4

TOTAL PRECIPITATION AND AVERAGE FLOW RECORDS
FOR STUDY PERIOD (MARCH, 1971-FEBRUARY, 1972)

<u>Month</u>	<u>Rainfall (Inches)</u>	<u>Flow to Plant (MGD)</u>	<u>Flow to Summit (MGD)</u>	<u>Flow to River (MGD)</u>	<u>Average Daily Passaic River Flow (MGD)</u>
March, 1971	3.45	2.54	1.41	1.13	225.
April, 1971	3.10	2.17	1.15	1.02	125.
May, 1971	3.28	1.77	1.17	0.61	84.
June, 1971	1.01	1.64	1.03	0.61	25.
July, 1971	7.65	1.62	0.89	0.73	200.
August, 1971	12.35	2.32	1.00	1.32	236.
September, 1971	10.35	2.51	1.22	1.29	461.
October, 1971	4.90	2.02	1.17	0.85	110.
November, 1971	5.05	2.20	1.08	1.12	175.
December, 1971	2.25	1.92	1.21	0.71	141.
January, 1972	3.39	1.97	1.27	0.70	115.
February, 1972	4.90	2.10	1.34	0.76	164.
Total Precipitation:	61.68				
Average Flows:		2.06	1.16	0.90	172.



tion system. The Borough Engineer undertook a sampling and testing program of the industries in the Borough. The source of the toxic waste was determined and pretreatment of this waste was instituted by the industry, so that by March of 1971, testing of plant operations could be started.

Evaluation of Plant Performance During Periods of Dry Weather Flow

During dry weather flow conditions, the plant was sampled on five separate occasions for a total of fifteen days. The results of these analyses are summarized in Table 5. The detailed analyses and flow charts are contained in Appendix B.

During these dry weather flow periods, approximately 0.54 MGD was removed from the primary clarifier leveling reservoir and discharged onto the plastic media trickling filter after combining with approximately 0.8 MGD of recirculation flow. The 0.54 MGD which was removed from the primary clarifier leveling reservoir was a combination of the transfer pump effluent and the overflow which occurred from the primary clarifier. During dry weather flow conditions, the filters normally operate in series.

The March, April and August tests were made on six or twelve-hour composite samples of the raw sewage, primary clarifier effluent, plastic media trickling filter effluent, rock media trickling filter effluent and final effluent. The November and December tests were made on twelve or twenty-four hour composite samples taken at the same locations.

The March, April and August episodes were typical dry weather flow conditions in that they were preceded by long-term dry weather conditions. However, the November and December studies were made immediately after a storm flow had terminated. This was done in order to find out how rapidly the plant returned to normal operation. The high storm flow had been expected to have an effect on the efficiency of the treatment plant by washing off some of the biological media from the filters. The results indicated that almost immediately upon return to series operation, a high degree of efficiency resulted and there was no detrimental effect from the high hydraulic loadings during storm flows.

A possible explanation for the phenomena of rapid return to high efficiency following a storm is that the high hydraulic rates which generally occur serve to wash off much of the accumulated slime on the support media, leaving a relatively thin film which is capable of readily assimilating the lower organic loads which occur.

The hydraulic loadings on the plastic media filter during the test period ranged between 55 to 60 MGAD. The organic loading varied from 26.8 to 35.4 pounds per thousand cubic feet. The plastic media filter

TABLE NO. 5
SUMMARY OF DRY WEATHER TEST RESULTS

Episode No.	Flow to River In MGD	Recirculation Rate In MGD	Raw Sewage		Final Effluent		Overall Plant Efficiency	
			B.O.D. MG/L	Susp. Solids MG/L	B.O.D. (MG/L)	Susp. Solids MG/L	B.O.D.	Susp. Solids
#1 (3/18/71 to 3/19/71)	0.6	0.8	-	-	27.	24.	-	-
#2 (4/22/71 to 4/23/71)	0.5	0.8	178.	166.	19.	20.	89.4%	83.0%
#3 (8/25/71 to 8/26/71)	0.5	0.8	193.	171.	32.	20.	83.4%	88.3%
#4 (11/5/71 to 11/12/71 and 11/15/71 to 11/17/71)	0.6	0.8	150.	142.	18.	21.	88.0%	85.3%
#5 (12/2/71 to 12/5/71)	0.5	0.8	150.	137.	19.	12.	87.4%	90.6%
Weighted Averages	0.54	0.8	167.	153.	23.	20.	86.2%	87.0%

TABLE NO. 5 (Continued)

SUMMARY OF DRY WEATHER TEST RESULTS

Episode Number	Flow To River (MGD)	Recirculation Rate (MGD)	Plastic Filter		Rock Filter		Secondary Clarifier Overflow Rate Gal/Day/Ft ²
			Hydraulic Loading MGAD	Organic Loading Lbs/1000 Ft. ³	Hydraulic Loading MGAD	Organic Loading Lbs/1000 Ft. ³	
#1 (3/18/71 to 3/19/71)	0.6	0.8	60.	33.8	18.3	22.4	156.
#2 (4/22/71 to 4/23/71)	0.5	0.8	55.	33.0	17.0	15.7	130.
#3 (8/25/71 to 8/26/71)	0.5	0.8	55.	35.4	17.0	29.6	130.
#4 (11/5/71 to 11/12/71 and 11/15/71 to 11/17/71)	0.6	0.8	60.	30.8	18.3	19.6	156.
#5 (12/2/71 to 12/5/71)	0.5	0.8	55.	26.8	17.0	18.1	130.
Weighted Averages	0.54	0.8	57.2	32.0	17.6	21.1	141.5

TABLE No.5 (Continued)
SUMMARY OF DRY WEATHER TEST RESULTS

Episode No.	NH ₃ -N In Mg/l					NO ₃ -N In Mg/l				
	Raw Sewage	Primary Effluent	Plastic Filter Effluent	Rock Filter Effluent	Final Effluent	Raw Sewage	Primary Effluent	Plastic Filter Effluent	Rock Filter Effluent	Final Effluent
#1 (3/18/71 to 3/19/71)	-	22.3	17.4	21.7	27.8	-	1.42	0.18	0.07	0.
#2 (4/22/71 to 4/23/71)	29.0	29.0	33.0	35.0	29.0	0.27	0.42	0.85	0.58	0.85
#3 (8/25/71 to 8/26/71)	37.0	32.0	19.0	21.0	19.0	0.01	0.01	0.42	0.83	0.61
#4 (11/5/71 to 11/12/71 and 11/15/71 to 11/17/71)	10.7	13.6	5.1	5.2	4.2	0.08	0.20	9.7	9.1	9.4
#5 (12/2/71 to 12/5/71)	21.0	16.0	8.0	7.0	8.0	0.25	0.60	11.5	13.2	12.1
Weighted Averages	23.8	22.2	16.1	17.6	17.5	0.15	0.55	4.56	4.74	4.60

removed approximately 17.2 to 25.7 pounds of BOD per thousand cubic feet. The rock media filter, on the other hand, was subjected to hydraulic loadings of from 17 to 18.3 MGAD and an organic loading varying from 18.1 to 29.6 pounds per thousand cubic feet. BOD removals on the rock filter varied from 7.7 to 12.1 pounds per thousand cubic feet.

The plastic media trickling filter, per equivalent volume, removed considerably more BOD than the rock media trickling filter. This is to be expected since the plastic media filter served as the lead filter during dry weather plant flow. As BOD removal in a trickling filter is a mass transfer reaction, the higher the incoming BOD concentration, the greater will be the amount of removal.

Nitrification

Nitrification was not detected until the August sampling episodes which indicated a substantial loss of ammonia with little increase in nitrate. This was also found to occur during the December dry weather test at the plant. It is interesting to note that the plastic media filter with a hydraulic loading rate of 55 to 60 MGAD, produced most of the nitrification which took place in this plant. The average organic loading rates during this time period ranged from 26.8 to 30.8 pounds of BOD per thousand cubic feet of filter volume.

The presence of substantial quantities of nitrate at these loading rates is unique. Prior investigations have shown that while some trickling filter operations result in nitrification, it was generally found to occur at lower hydraulic loading rates and during periods of higher ambient air temperature.

It would appear that nitrification began to occur after about six to eight months of operation. The loss of nitrogen observed in the August tests without an increase in nitrate concentration could be due to denitrification in the secondary clarifier. It is quite surprising that significant nitrification occurred during the November and December tests when a slight amount of nitrification, due to low temperature, is normally expected to occur. The fact that no further nitrification occurred in the rock media filter is also contraindicated because of the low applied organic loading rates and the low applied hydraulic rates.

Evaluation of Plant Performance During Periods of Wet Weather Flow

The sampling points used were the same as employed for the dry weather flow studies.

When rain was forecast in the watershed the treatment plant personnel were placed on a storm "alert".

Plant personnel were informed before hand of the desired mode of plant operation. When rain began to fall on the watershed, the samplers were turned on and the analyses began immediately following the collection of the first six-hour sample. Samples were composited according to flow to make a twenty-four hour composite sample.

Plant Operation

When the combined infiltration and raw sewage flow at the treatment facilities reached 2.8 MGD, the trickling filter units were automatically placed into a parallel mode of operation at a set flow split in lieu of the normal dry weather series operation.

During this study, all of the raw sewage was allowed to pass through the treatment plant. Pumping to the Summit system was undertaken only to the extent required to prevent a buildup of sludge in the primary clarifier.

Raw Sewage Characteristics During Storm Flow

Figure 16 shows the effects of infiltration on the raw sewage during a storm. This figure indicates that as infiltration increases, the concentration of BOD and suspended solids decrease, as expected. At the higher flow rates of 3 MGD and above, the BOD concentration is about 125 mg/l or less. This points out the fact that the treatment plant is confronted with removing the BOD from a weak strength sewage at an extremely high flow rate.

Results of Sampling and Analyses

Six storm episodes were sampled during this study. The summarized results are contained in Table 6 and detailed in Appendix C. The figures showing the precipitation and plant flow versus time for each storm are also contained in Appendix C.

Primary Clarifier

The primary clarifier leveling reservoir functions primarily as a settling tank during wet weather periods. Under storm flow conditions, this unit also serves to store sludge from the settled raw sewage as well as the return sludge from the final clarifier. However, during the storm periods, bottom sludge is intermittently removed from the primary clarifier and is pumped to Summit.

FIGURE 16
BOD AND SUSPENDED SOLIDS CONCENTRATION
VERSUS
RAW SEWAGE FLOW IN MGD

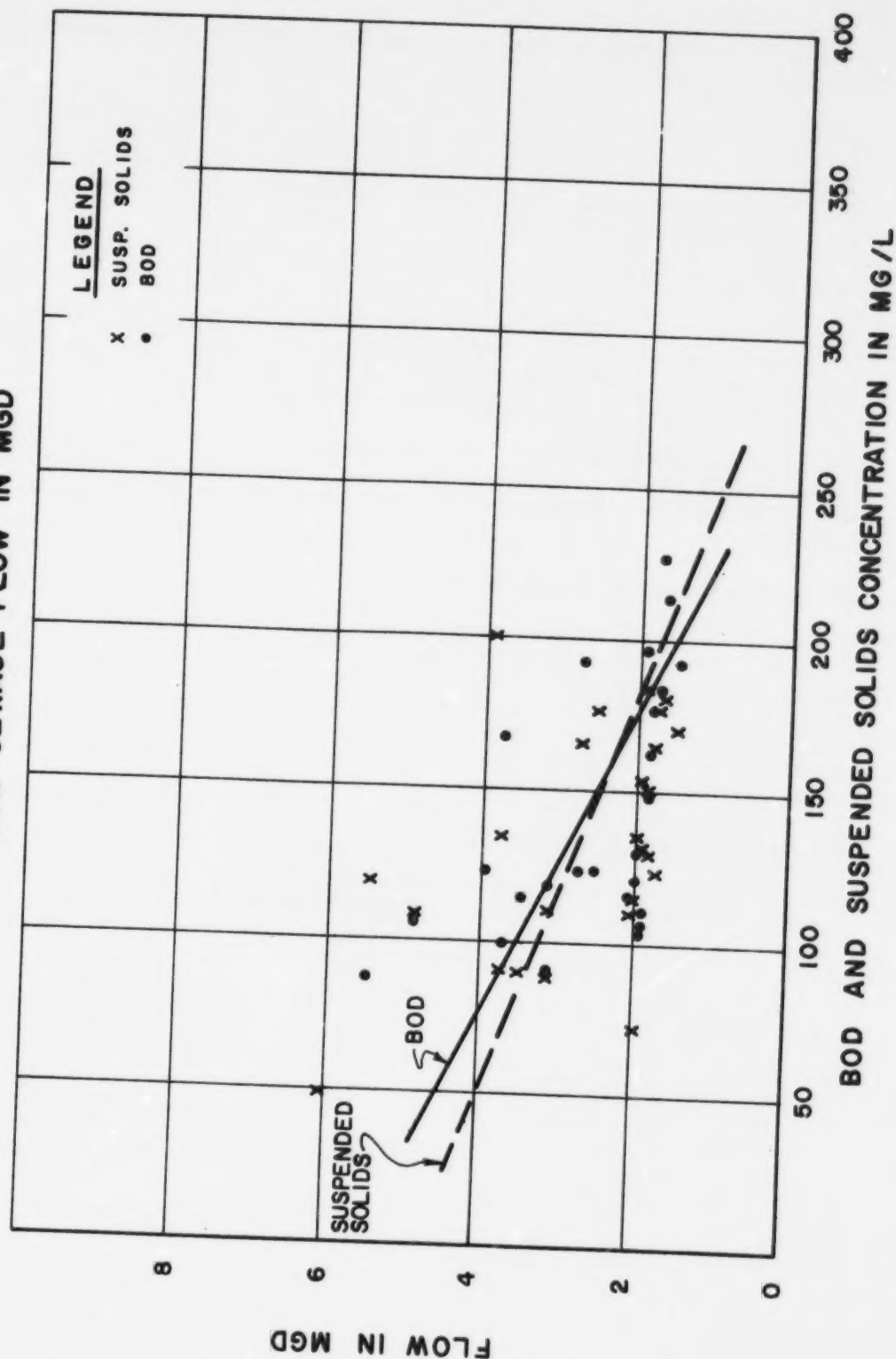


TABLE NO. 2

SUMMARY OF WET WEATHER TEST RESULTS

Storm No.	Average Flow To River In MGD	Raw Sewage		Final Effluent		Overall Plant Efficiency	
		BOD (Mg/l)	Susp. Solids (Mg/l)	BOD (Mg/l)	Susp. Solids (Mg/l)	BOD	Susp. Solids
#1 (4/7/71 to 4/9/71)	4.60	-	-	43.	39.	-	-
#2 (5/13/71 to 5/14/71)	3.00	168.	135.	73.	47.	56.6%	65.2%
#3 (8/27/71 to 8/29/71)	5.80	67.	79.	29.	35.	56.7%	55.7%
#4 (9/13/71 to 9/14/71)	4.63	107.	108.	27.	23.	74.8%	78.7%
#5 (11/1/71 to 11/5/71)	2.70	122.	170.	34.	25.	72.1%	85.3%
#6 (11/29/71 to 12/2/71)	3.00	124.	110.	41.	51.	66.9%	53.6%
Average	3.96	109.	112.	39.	36.	64.3%	67.9%

TABLE NO. 6 (Continued)

SUMMARY OF WET WEATHER TEST RESULTS

	NH ₃ -N in Mg/l				NO ₃ -N in Mg/l					
	Raw Sewage	Primary Effluent	Plastic Filter Effluent	Rock Filter Effluent	Final Effluent	Raw Sewage	Primary Effluent	Plastic Filter Effluent	Rock Filter Effluent	Final Effluent
#1 (4/7/71 to 4/9/71)	-	13.4	6.0	8.3	7.0	-	0.81	0.81	0.67	0.78
#2 (5/13/71 to 5/14/71)	23.6	25.6	30.2	25.0	25.6	-	0.71	2.4	3.0	3.1
#3 (8/27/71 to 8/29/71)	7.2	7.3	6.0	10.2	11.2	0.12	0.30	0.83	0.70	1.4
#4 (9/13/71 to 9/14/71)	1.5	1.8	2.5	3.5	2.5	0.19	0.18	0.44	0.65	0.42
#5 (11/1/71 to 11/5/71)	11.8	9.0	7.1	7.3	7.8	0.73	2.0	3.2	2.5	3.9
#6 (11/29/71 to 12/2/71)	7.5	7.1	7.1	5.4	6.8	1.4	1.7	5.1	5.7	6.4
Average	9.1	9.9	8.7	9.5	9.6	0.47	0.80	1.76	1.81	2.22

The solids return from the final clarifier is controlled by a sludge drawoff line. The rate of secondary sludge withdrawal is controlled by a plug valve located on the sludge outlet line. This valve is normally left partially open during storm flows, which allows the continuous removal of sludge from the final clarifier. The flow rate from the sludge drawoff line is estimated to be about 70 GPM during storm flows.

During storm flow episodes, the overflow rate of the primary clarifier ranged from about 1,525 GPD per square foot to about 3,000 GPD per square foot. The suspended solids and BOD removal efficiencies of the primary clarifier have been plotted in Figure 17. It will be noted that at overflow rates of less than 2,000 GPD per square foot, the efficiency of the primary clarifier, as measured by suspended solids removal, is generally above 60 per cent. However, at overflow rates greater than 2,000 GPD per square foot, the removal efficiency becomes erratic and drops off perceptibly. At an overflow rate of 3,000 GPD per square foot, the suspended solids removal efficiency was found to be only about 8 per cent. An overflow rate of 3,000 GPD per square foot is approximately three times the normal design value for a primary clarifier. On the other hand, the suspended solids in the sewage was extremely low because of the dilution resulting from the high storm water flow, and with a low suspended solids concentration, a high percentage of removal was not expected.

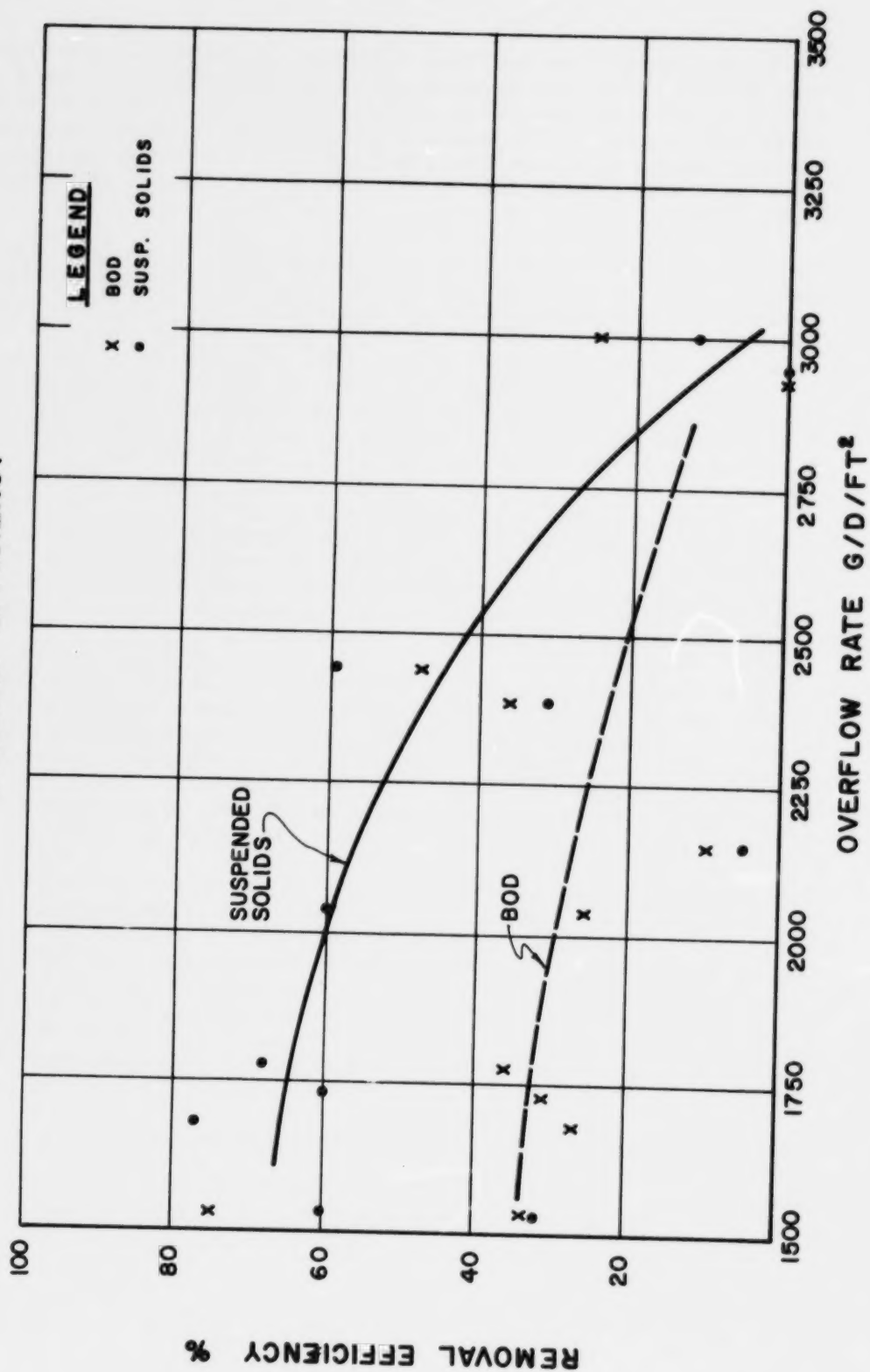
There is considerable variation in the data concerning the performance of the primary clarifier. While the primary clarifier leveling reservoir is relatively deep, namely, 29 feet, it is believed that the sludge level has a tendency to build up during a storm. Therefore, some of the accumulated sludge appears to have been carried over the weir resulting in lower removal efficiencies than might otherwise have resulted. This was a result of not using the pumps to Summit.

The BOD removal from the primary clarifier, at an overflow rate of about 1,500 GPD per square foot, was found to be about 30 to 35 per cent, which is somewhat higher than was expected at this flow rate. As the overflow rate increased, the BOD removal efficiency decreased to approximately 10 per cent removal at an overflow rate of about 3,000 GPD per square foot. The BOD removal curve does not precisely parallel the suspended solids removal curve. This is attributed to the build up of sludge in the primary clarifier which was carried over the weirs at very high overflow rates.

Performance and Efficiency of the Trickling Filters

The performance and efficiency of the trickling filters while operating in parallel during wet weather or storm flow episodes has been

FIGURE 17
PRIMARY CLARIFIER OVERFLOW RATE
VERSUS
REMOVAL EFFICIENCY



determined. Figure 18 is a plot of the applied hydraulic and organic loadings for the rock media and plastic media trickling filters as related to BOD removal. The data used is based upon test results of 24-hour composite samples. The applied loading to the filters were predicated upon the primary clarifier effluent flow and waste characteristics. The efficiencies of the trickling filters were determined following sedimentation of the trickling filter effluent in the laboratory.

The applied hydraulic loading on the rock media filter varied from 15 to 53 MGAD. The applied organic load varied between 30 to 62 lbs. of BOD per 1,000 cubic feet of filter volume.

At hydraulic loading rates of about 15 to 20 MGAD, the BOD removal varied from 44 per cent to 64 per cent. As hydraulic loading rates increased beyond 20 MGAD, the removal was lower. For example, at an applied hydraulic loading of about 50 MGAD, the BOD removal decreased to about 30 per cent.

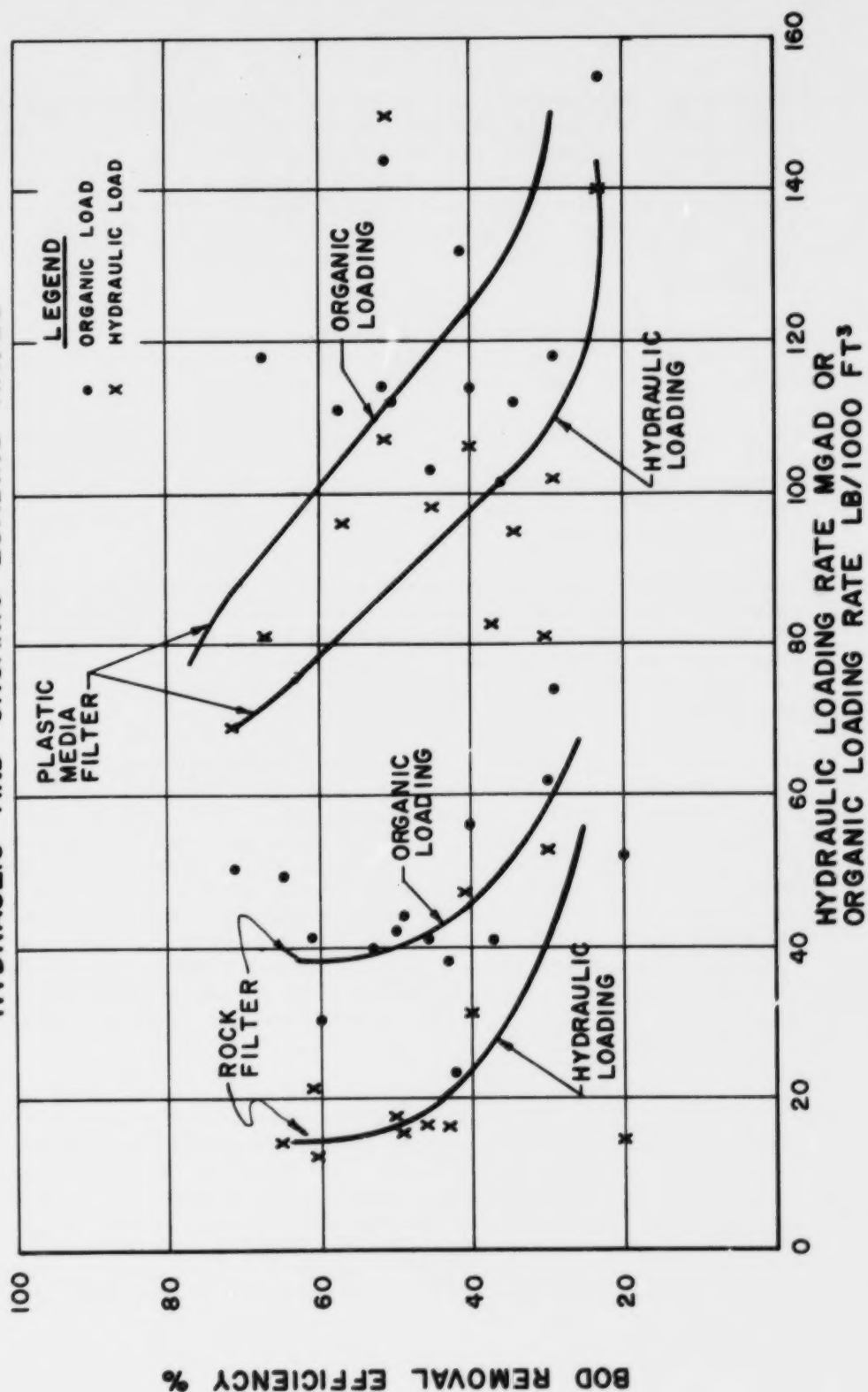
Organic removal from the rock media filter also decreased as the applied organic loadings increased. BOD removals were found to be about 50 per cent at applied organic loadings of about 40 lbs. per 1,000 cubic feet of filter volume. The BOD removal decreased to about 30 per cent when the applied organic load on the rock media filter was increased to about 60 lbs. per 1,000 cubic feet.

The plastic media trickling filter was loaded at significantly higher applied hydraulic loading rates than the rock media filter. The applied hydraulic loading rates on the plastic media filter varied from 80 MGAD to about 150 MGAD. At 80 MGAD the BOD removal efficiency of the plastic media filter was found to be about 60 per cent. This removal efficiency dropped off significantly as the loading rate was increased. For example, at an applied hydraulic loading rate of about 110 MGAD, the BOD removal was found to be only 40 per cent. An increase in the applied hydraulic loading beyond this rate further decreased the efficiency of the filter. At an applied hydraulic rate of approximately 140 MGAD, the BOD removal efficiency of the plastic media filter dropped to about 20 per cent.

Similarly, increased applied organic loading rates resulted in lower efficiency or lower BOD removal in the plastic media filter. At an organic loading rate varying from 100 to 120 pounds per thousand cubic feet, the BOD removal varied from about 40 to 60 per cent. By increasing the applied organic loading rate to about 150 pounds per thousand cubic feet, the BOD removal decreased to about 30 per cent.

The effect of an increased applied hydraulic loading is to reduce BOD removal efficiency, and this is attributed to the fact that less con-

FIGURE 18
BOD REMOVAL EFFICIENCY
VERSUS
HYDRAULIC AND ORGANIC LOADING RATES



tact time is afforded for biological reduction in the plastic media filter. In addition, as the applied hydraulic loading increases, the sewage concentration becomes weaker and the reduction in BOD is further affected.

Filter failure never occurred during this testing period. The filters showed BOD reduction in all instances, with the exception of periods when the primary clarifier effluent contained such a low concentration of BOD, which occurred generally after the system was flushed of all the accumulated solids, that it passed through the treatment facilities unreduced.

A direct comparison between the plastic media filter and the rock media filter in terms of BOD removal efficiency during storm flows indicates that the plastic media trickling filter removed considerably more BOD per 1000 ft³ than the rock media trickling filter. For example, the plastic media trickling filter removed about 54 lbs. of BOD per 1000 ft³, while the rock filter removed only 20 lbs. of BOD per 1000 ft³ at 45 per cent efficiency.

The plastic media filter removed about 2.7 times the BOD of the rock filter. The construction costs for the filters are given in Table 2, which indicates that the construction cost of the rock media filter was about 25 per cent less than the plastic media filter. However, based on the lbs. of BOD removed per 1000 ft³ of media, the construction cost of the plastic media filter amounted to \$1870 per lb. of BOD removed per 1000 ft³, while the rock media filter construction cost amounted to \$3810 per lb. of BOD removal per 1000 ft³ of media at a 45 per cent BOD removal efficiency.

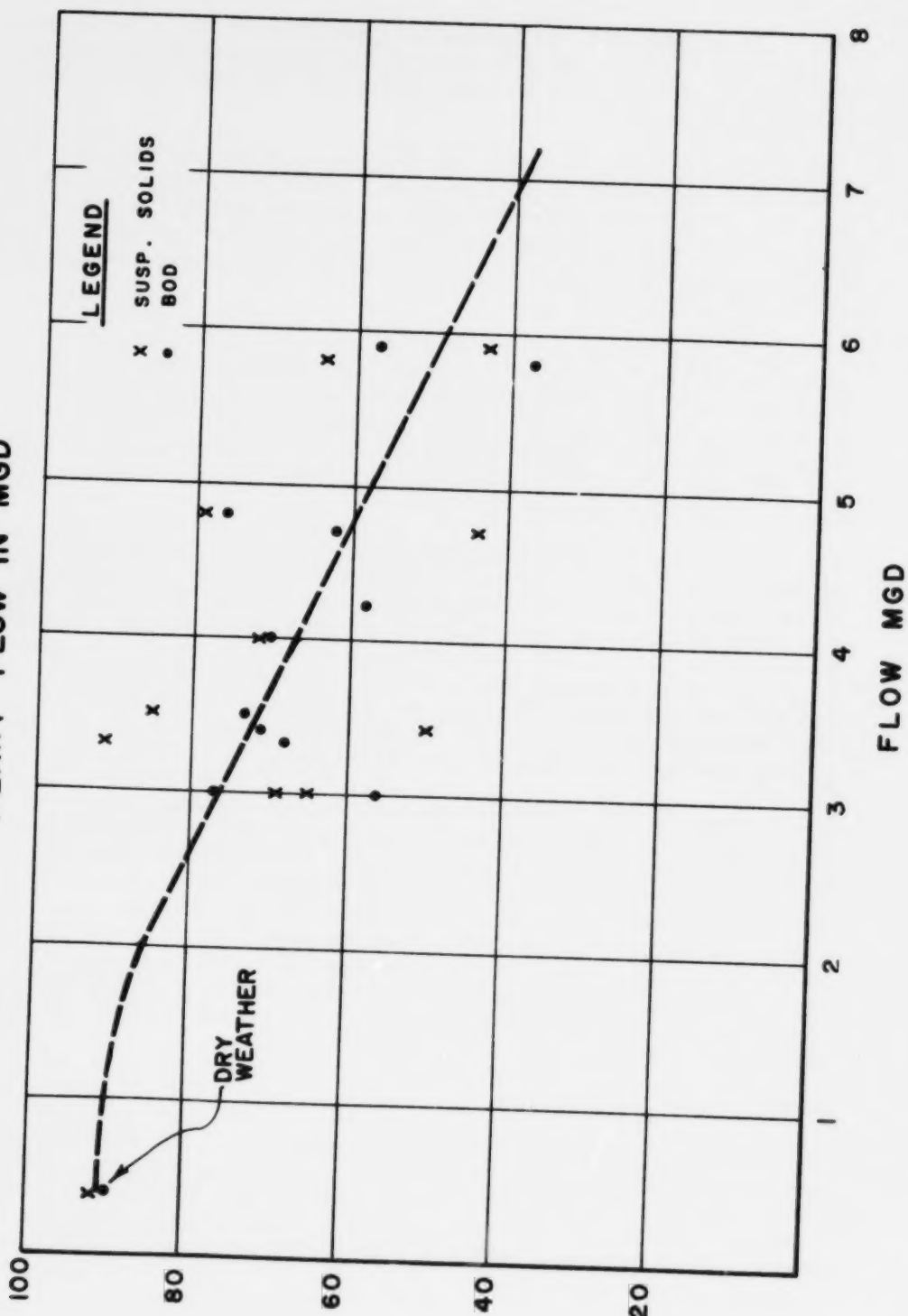
The reasons for the higher efficiency of the plastic versus the rock trickling filter cannot be explained except that its position as lead filter during dry weather operation may influence its efficiency during wet weather. Also, the rock filter serves as the second filter during dry weather operation and receives a low concentration organic load. During wet weather, the concentration increases significantly; however, it is believed that the biological population necessary to bring about oxidation does not adjust itself that rapidly to the change in hydraulic and organic load, thus accounting for the reduced efficiency observed.

Overall Plant Performance

The overall plant performance as measured by the BOD and suspended solids removal is shown on Figure 19. This data indicates that as the flows entering the plant increased, the BOD and suspended solids removals decreased. However, it must be kept in mind that the dry weather plant flow was only 0.5 MGD and the wet weather flow approached

FIGURE 19
 BOD & SUSPENDED SOLIDS REMOVAL EFFICIENCY
 VERSUS
 PLANT FLOW IN MGD

OVERALL BOD AND SUSPENDED SOLIDS REMOVAL EFF. %



6.0 MGD, a flow increase of twelve times, the efficiency only decreased from 87 per cent to 50 per cent. This decrease in efficiency may be due to the parallel operation of the filters during periods of high infiltration as opposed to the more effective series filter operation during dry weather flow, as well as the effect of a weaker concentration sewage during periods of excessive flow.

Wet Weather Flow as Related to Rainfall

An attempt was made to correlate rainfall with wet weather flow at the treatment plant. Figure 20 was prepared to indicate the increase in wet weather or storm flow due to rainfall. It must be kept in mind that this chart is an oversimplification of the relationship between precipitation and plant flow and is more representative of the approximation of increased plant flow. Such factors as antecedent precipitation, intensity and duration of the rainfall, groundwater table levels and seasonal factors, including temperature, all have a significant effect upon the amount of storm water runoff which may reach the plant.

Two general observations were made concerning the effect of precipitation upon the wet weather or storm flow entering the plant. If a given rainfall were preceded by one or more rainfalls within a 1-1/2 week period, the increase in plant flow would be appreciable. The increase could be as much as twice the flow which would result following a rainfall of similar intensity that occurred after an extensive dry weather period. On the other hand, if no rainfall had occurred for a 2 to 3 week period, a heavy precipitation could have only a nominal effect upon the treatment plant flow. It was also observed that in general, intermittent or consistent rainfall extending over a period of several days resulted in a greater storm water flow into the plant than might occur with a highly concentrated rainfall of only short term duration.

Studies of Chemical Treatment to Improve Process Efficiency

During the last period of heavy infiltration sampled in December, 1971, steps were taken to study possible improvement in treatment efficiency by the utilization of chemicals. Laboratory studies were undertaken and showed that increased suspended solids removal did increase treatment efficiency. The results of these tests are contained in Table 7.

The addition of alum and a cationic polyelectrolyte (Dearborn 418) was made in an effort to improve the quality of the final effluent under storm flow conditions.

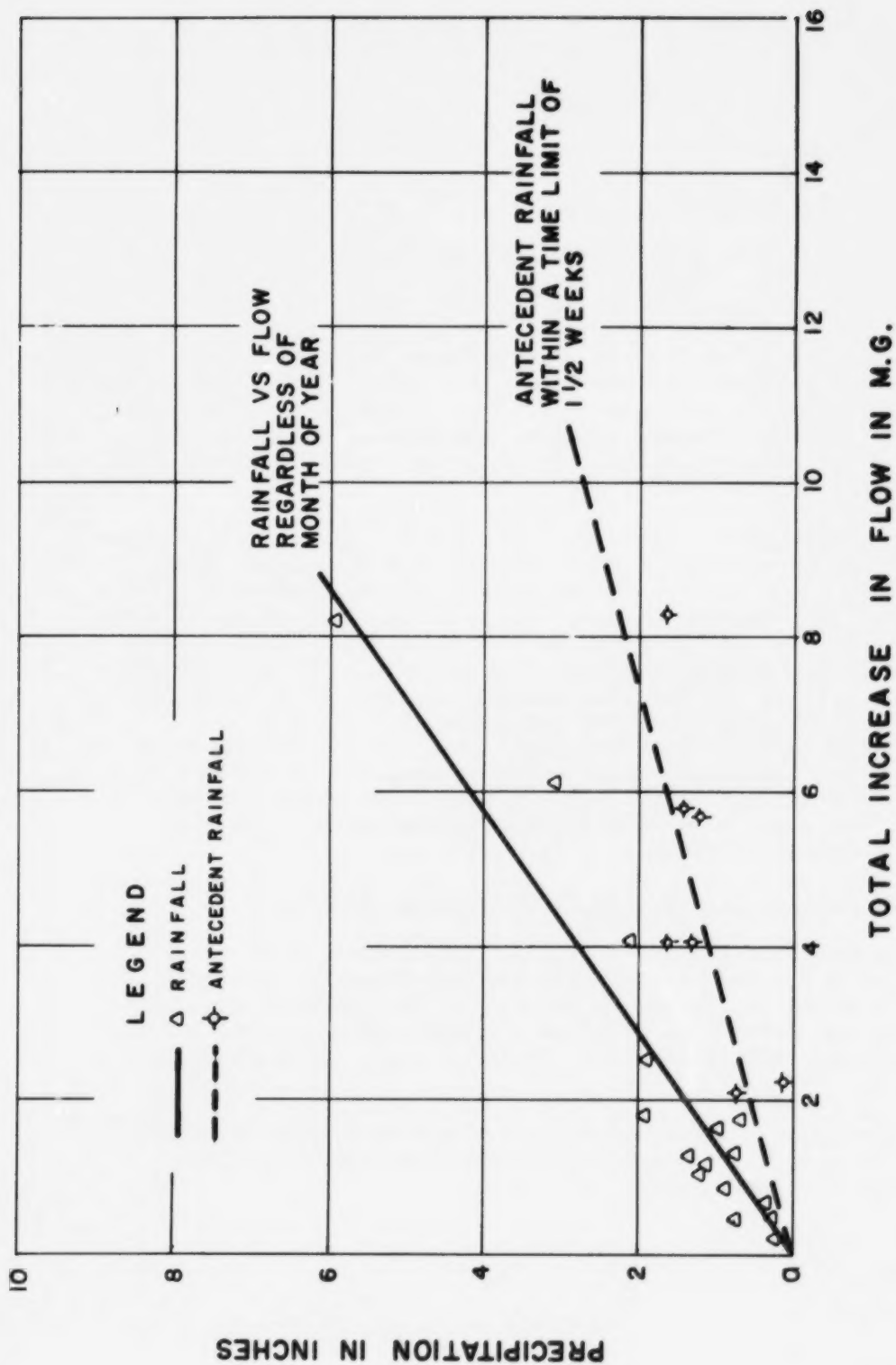


FIGURE 20
PRECIPITATION VS INCREASE IN FLOW

TABLE 7
COMPARISON OF BOD RESULTS
SECONDARY CLARIFIER EFFLUENT
BEFORE AND AFTER FILTERING

<u>Episode No.</u>	<u>Time of Sampling</u>	<u>BOD in Mg/l</u>	
		<u>Before Filtering</u>	<u>After Filtering</u>
Dry Weather No. 3 8/25/71 to 8/26/71	7 AM - 1 PM	34	20
	1 PM - 7 PM	29	7
	7 PM - 1 AM	38	17
	1 AM - 7 AM	26	16
Storm No. 3 8/27/71 to 8/28/71	9 AM - 3 PM	21	13
	3 PM - 9 PM	49	24
	9 PM - 3 AM	40	22
	3 AM - 9 AM	37	14
Storm No. 4 9/13/71 to 9/14/71	5 PM - 11 PM	33	27
	11 PM - 5 AM	19	12
	5 AM - 11 PM	12	8
Average		31	16

Effective BOD Removal By Filtering Secondary Effluent = 48.4%

Laboratory studies of the waste indicated that an application of 30 mg/l of alum and 1 mg/l of a cationic polyelectrolyte would improve sedimentation in the final clarifier. Laboratory tests were performed on the combined filter effluents prior to sedimentation. 800 milliliters of the waste was placed in 1,000 milliliter beakers. Various dosages of alum were added and the results observed. All samples were rapidly mixed for one minute after the addition of alum. Flocculation for five minutes at 20 RPM followed the rapid mixing. The samples were then allowed to settle for 30 minutes.

The following results were observed:

<u>Alum Dosage mg/l</u>	<u>Floc Formation</u>	<u>Floc Appearance</u>	<u>Settling Characteristics</u>
0			
10	Immed	Medium	Slow
20	Immed	Medium	Slow
30	Immed	Large	Rapid
40	Immed	Large-Some Pinpoint	Rapid
50	Immed	Pinpoint	Slow - Partial Removal
60	Immed	Small	Poor

The tests were rerun using 30 mg/l alum dosage and the various polymer dosages shown. The following results were obtained:

Polymer 418 - Dearborn

<u>Dose mg/l</u>	<u>Settling Characteristics</u>
0.1	Fair - Cloudy Supernatant
0.5	Cloudy Supernatant
1.0	Excellent
2.0	Excellent

Based on the above results, a dosage of 30 mg/l alum and 1.0 mg/l of a cationic polymer Dearborn-418 were recommended.

The dosage of alum was added to the effluent of the plastic media trickling filter. The dosage of polyelectrolyte was added to the effluent from the rock media trickling filter. Both effluents combine prior to entering the secondary clarifier, and it was anticipated that sufficient mixing would result so as to promote floc formation. It was also expected that flocculation would continue to take place in the secondary clarifier and result in improved solids removal.

The results indicated that no increased suspended solids removal occurred. In fact, the suspended solids in the final effluent appeared to be higher.

The hydraulic overflow rate of the secondary clarifier during this test period ranged from about 790 to 1,450 GPD per square foot. Even though manual variations in the chemical feed rates were undertaken in an effort to optimize operating conditions, a poor sized floc was developed which did not exhibit good settling characteristics. This was also observed in jar tests made at the site and verified by plant results during the full scale field tests.

It is obvious then that the laboratory testing did not accurately portray field conditions. However, we believe, based on the limited testing that the hydraulic overflow rate is the governing parameter as far as suspended solids removal is concerned. Chemical addition, by the mechanisms of coagulation and flocculation, can serve to agglomerate most, if not all, of the suspended solids. However, these larger particles are still subject to the same basic laws governing sedimentation. Therefore, it appears that no matter what attempts are made to increase the size and weight of particles, unless the overflow rates are in the range to promote sedimentation, these attempts must fail.

A more positive approach is to incorporate in the design either a sufficiently large clarifier to provide the low overflow rates necessary to insure good sedimentation under the conditions anticipated, or to install a pond following the secondary clarifier to provide sufficient detention time to accomplish sedimentation.

One of the drawbacks of high rate trickling filters for the treatment of high flows is the tendency for colloidal suspended material to be discharged from the filters. Unless chemical precipitation and low secondary overflow rates or supplemental biological flocculation in the form of a pond are included, good suspended solids removal and high BOD removal will not be obtained.

Additional Studies - 1972

Subsequent studies of the dry weather flow are summarized in Table 8 and are contained in detail in Appendix D. These samples were collected and analyzed by plant personnel. They are 24 hour composite samples.

The results indicate an improved efficiency in terms of BOD removal over the dry weather studies conducted during 1971.

TABLE 8
SUMMARY OF RESULTS OF SAMPLING
BY PLANT PERSONNEL
FROM
JANUARY TO JULY, 1972

	Dry Weather Flow					Infiltration Flow				
	No. Samples	Avg Daily Flow (MGD)	% BOD Removal	Avg Eff BOD (MG/l)	% SS Removal	Avg Eff SS (MG/l)	No. Samples	Avg Daily Flow (MGD)	% BOD Removal	Avg Eff BOD (MG/l)
Jan	2	0.63	93	12	90	18	2	1.76	94	12
Feb	10	0.58	93	13	92	16	2	0.98	87	19
Mar	17	0.62	95	7	92	12	5	3.30	83	19
Apr	13	0.52	95	7	94	9	7	1.61	86	21
May	18	0.58	94	7	95	9	3	1.42	89	12
June	14	0.51	94	8	95	8	7	2.08	83	20
July	18	0.48	94	10	88	16	1	0.94	90	13
										81
										22

One significant change during dry weather operations which may account for the improved efficiency has been the practice of allowing the plant to go into the parallel mode of operation for several hours three to five times per week. This practice has served to increase the food supply to the rock filter. This accomplishment has increased the efficiency of the rock filter during dry weather periods and points out the need to provide a sufficient food source to promote a good biota for biological oxidation to take place.

It has now become the practice of plant personnel to run the Summit pumps continuously during periods of high infiltration. This has served to accomplish a reduction in the hydraulic and organic loadings on the filters and insures that there has been no build up of sludge in the primary clarifier leveling reservoir.

The plant was sampled on October 14, 1972, and the results are shown on Table No. 39 and Figure 28, and are incorporated into Figure 18. These results clearly point out the advantages gained by reducing the hydraulic and organic loads to the filters.

In order to obtain 60 to 70 per cent removal by the filters, it appears that it is necessary to limit the design of the rock filter to an organic loading of about 40 lbs. per 1000 cubic feet and a hydraulic loading of about 20 MGAD. Similarly, the plastic filter should be designed for a hydraulic loading of 70 to 80 MGAD and an organic loading of 80 to 120 lbs. of BOD per thousand cubic feet.

This plant is unique in that it possesses an additional safety factor in order to reduce the hydraulic and organic loadings. This is accomplished by means of the Summit pumps. Plants not so equipped will be forced to limit loadings to the above ranges, depending on their objective of treatment.

SECTION VII

COST OF OPERATION

The following is the approximate annual cost of operation of the treatment plant for 1971.

<u>Description</u>	<u>Cost</u>
Salaries and Wages	\$45,000.00
Utilities (Telephone, Water, Gas, Electricity)	22,000.00
Chlorine (Gas)	2,500.00
Repairs, Materials, Chemicals and Supplies	9,000.00
Pensions, Social Security Insurance, Hospitalization, Etc.	7,000.00
Engineering and Administrative	<u>5,000.00</u>
Total Borough of New Providence Cost	\$90,000.00

The total annual cost for sewage pumped to the City of Summit system was \$80,400.00.

Therefore, the total annual operating cost during the study period was \$170,400.00.

In 1971, the treatment facilities handled a total of 751 MG, which was generally disposed of as tabulated below:

Pumped to City of Summit.	423 MG
Treated at Plant Daily under Dry Weather Flow Conditions	220 MG
Treated under Storm Flow Conditions.	<u>108 MG</u>
TOTAL FLOW - 1971	751 MG

The operating cost for processing the entire flow of 751 MG is \$227 per million gallons.

The operating cost of treating only the flow which passed through the treatment facilities, namely, the dry weather and wet weather flow, which amounted to 328 MG is \$274 per million gallons.

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This latter figure does not include the costs associated with pumping of sewage to the City of Summit.

If the costs of construction are based on the dry weather flow, then the cost of the New Providence Plant amounted to \$2.00 per gallon, while a 10 MGD plant designed along these lines, namely, series operation during dry weather and parallel operation during wet weather, was found to have a construction cost of \$1.00 per gallon of dry weather flow.

The costs of operation of the New Providence facility are within the range expected for treatment plants of this size. A conventional treatment plant with sludge digestion would process the same flow for about \$300.00 per million gallons. As indicated previously, the costs of operation for processing the flow through the plant was \$274.00 per million gallons, which is slightly less than the cost associated with a conventional treatment facility.

SECTION VIII

ACKNOWLEDGMENTS

We wish to thank Mr. John McCann, Borough Engineer for the Borough of New Providence, Plant Superintendent, and his staff for their assistance, cooperation and recommendations during this period of study.

In addition, the comments and patience of Mr. Anthony N. Tafuri, Project Advisor, Storm and Combined Sewer Overflow Technology Branch, Office of Research and Development, U.S. Environmental Protection Agency, National Environmental Research Center, Edison, New Jersey, are greatly appreciated.

This report was prepared by the firm of Elson T. Killam Associates, Inc., Millburn, New Jersey, of whom the principal authors are respectfully, President, Vice President and Associate.

SECTION IX

APPENDICES

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APPENDIX A

FLOW DATA

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TABLE 9
PRECIPITATION AND FLOW RECORDS FOR MARCH, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		2.83	1.57	1.26	413.
2		2.29	1.71	0.58	356.
3		3.00	0.16	2.84	292.
4	1.15	3.86	0.52	3.34	286.
5		3.27	1.72	1.55	245.
6		2.86	1.76	1.10	249.
7	0.95	4.69	1.84	2.85	386.
*8		3.40	1.86	1.54	430.
*9		2.46	1.82	0.64	420.
*10		2.36	1.75	0.61	359.
*11		2.20	1.66	0.54	296.
*12		2.09	1.64	0.45	229.
*13		2.24	1.64	0.60	205.
*14	0.10	2.02	1.53	0.49	183.
*15		2.19	1.45	0.74	159.
*16		2.18	1.61	0.57	149.
*17		1.99	1.42	0.57	131.
*18		2.01	1.40	0.61	114.
*19	1.25	3.61	0.42	3.19	155.
*20		4.48	1.19	3.29	316.
*21		2.41	1.70	0.71	325.
*22		3.37	1.74	0.63	287.
*23		2.00	1.51	0.49	233.
*24		2.13	1.43	0.70	167.
25		1.94	1.35	0.59	124.
26		1.82	1.22	0.60	103.
27		1.77	1.18	0.59	90.
28		1.75	1.13	0.62	81.
29		1.84	1.26	0.58	73.
30		1.83	1.21	0.62	69.
31		1.95	1.26	0.69	63.
Average		2.54	1.41	1.13	225.
Maximum		4.69	1.86	3.34	430.
Minimum		1.75	0.16	0.45	63.

*Raw Sewage Flow and Flow to River are Estimates since Raw Sewage Flow Meter was Inoperable

TABLE 10
PRECIPITATION AND FLOW RECORDS FOR APRIL, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		1.88	1.24	0.64	58.
2	0.15	1.78	1.12	0.66	54.
3		1.87	1.20	0.67	58.
4		1.81	1.20	0.61	56.
5		3.71	0.72	2.99	50.
6	2.70	2.08	1.07	1.01	58.
7		6.58	0.27	6.31	361.
8		3.97	0.12	3.85	506.
9		2.85	1.86	0.99	486.
10		2.57	1.30	1.27	431.
11		1.89	1.36	0.53	340.
12		2.39	1.19	1.20	241.
13		2.02	1.53	0.49	146.
14		1.72	1.30	0.42	107.
15		1.96	1.45	0.51	87.
16		1.85	1.26	0.59	75.
17		1.73	1.22	0.51	67.
18		1.71	1.18	0.53	61.
19		2.00	1.42	0.58	56.
20		1.82	1.28	0.54	52.
21		1.87	1.31	0.56	48.
22		1.80	1.20	0.60	45.
23		1.68	1.16	0.52	43.
24		1.57	1.10	0.47	40.
25		1.34	0.92	0.42	38.
26		1.84	1.19	0.65	37.
27		1.62	1.09	0.53	36.
28	0.20	1.71	1.08	0.63	36.
29	0.05	1.77	1.14	0.63	38.
30		1.65	1.01	0.64	39.
Average		2.17	1.15	1.02	125.
Maximum		6.58	1.86	6.31	506.
Minimum		1.34	0.12	0.42	36.

TABLE 11
PRECIPITATION AND FLOW RECORDS FOR MAY, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		1.62	1.05	0.57	38.
2	0.20	1.48	0.92	0.56	36.
3		1.68	1.19	0.49	38.
4		1.61	1.11	0.50	38.
5		1.68	1.16	0.52	35.
6	0.20	1.57	1.10	0.47	34.
7		1.53	1.03	0.50	35.
8	0.70	1.57	1.21	0.36	64.
9		1.33	0.94	0.39	114.
10		1.83	1.23	0.60	96.
11		1.75	1.18	0.57	78.
12		1.69	1.16	0.53	62.
13	1.20	3.79	0.33	3.46	136.
14		2.30	1.66	0.64	242.
15	0.10	1.80	1.20	0.60	187.
16	0.68	2.18	1.56	0.62	174.
17		2.01	1.53	0.48	204.
18		2.04	1.44	0.60	153.
19		1.78	1.29	0.49	111.
20		2.21	1.64	0.57	86.
21	0.20	1.59	1.30	0.29	80.
22		1.54	1.11	0.43	101.
23		1.49	1.02	0.47	87.
24		1.75	1.19	0.56	69.
25		1.72	1.17	0.55	58.
26		1.66	1.15	0.51	50.
27		1.68	1.15	0.53	44.
28		1.59	1.11	0.48	38.
29		1.33	0.85	0.48	34.
30		1.57	1.08	0.49	33.
31		1.58	1.08	0.50	56.
Average		1.77	1.17	0.61	84.
Maximum		3.79	1.66	3.46	242.
Minimum		1.33	0.33	0.29	33.

TABLE 12
PRECIPITATION AND FLOW RECORDS FOR JUNE, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		1.80	1.26	0.54	65.
2	0.11	1.72	1.16	0.56	54.
3		1.72	1.14	0.58	46.
4		1.72	1.24	0.48	43.
5		1.50	0.95	0.55	37.
6		1.48	0.91	0.57	30.
7		1.86	1.19	0.67	26.
8		1.81	1.20	0.61	24.
9		1.69	1.07	0.62	22.
10		1.41	1.01	0.40	20.
11		1.60	1.07	0.53	17.
12		1.66	1.08	0.58	17.
13	0.05	1.47	0.87	0.60	17.
14	0.05	1.57	1.05	0.52	21.
15	0.55	1.69	1.07	0.62	26.
16		1.58	1.09	0.49	27.
17		1.57	0.71	0.86	28.
18		1.84	1.01	0.83	22.
19		1.45	0.78	0.67	19.
20	0.25	1.81	1.09	0.72	16.
21		1.92	1.15	0.77	25.
22		2.02	1.13	0.89	33.
23		1.57	1.00	0.57	19.
24		1.61	1.06	0.55	16.
25		1.55	1.02	0.53	15.
26		1.30	0.86	0.44	15.
27		1.17	0.70	0.47	12.
28		1.73	1.08	0.65	12.
29		1.68	0.97	0.71	12.
30		1.66	0.97	0.69	11.
Average		1.64	1.03	0.61	25.
Maximum		2.02	1.26	0.89	65.
Minimum		1.17	0.70	0.40	11.

TABLE 13

PRECIPITATION AND FLOW RECORDS FOR JULY, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1	0.30	1.72	0.98	0.74	14.
2		1.47	0.92	0.55	19.
3		1.38	0.67	0.71	15.
4		1.32	0.64	0.68	12.
5		1.56	0.80	0.76	10.
6		1.56	0.86	0.70	10.
7		1.92	1.16	0.76	10.
8		1.54	0.80	0.74	10.
9		1.50	0.75	0.75	9.
10		1.45	0.75	0.70	8
11	0.05	1.17	0.65	0.52	8.
12		1.33	0.81	0.52	8.
13	0.95	1.23	0.73	0.50	8.
14	0.05	1.36	0.84	0.52	13.
15		1.44	0.94	0.50	11.
16	0.05	1.38	0.86	0.52	9.
17		1.50	0.87	0.63	8.
18		1.34	0.60	0.74	8.
19	0.50	1.49	1.02	0.47	12.
20		1.42	0.94	0.48	32.
21		1.39	0.96	0.43	22.
22		1.43	0.92	0.51	14.
23		1.24	0.94	0.30	10.
24	0.85	1.56	0.78	0.78	8.
25	0.15	2.33	1.61	0.72	30.
26	0.95	1.86	1.23	0.63	28.
27		1.76	0.80	0.96	26.
28		1.82	1.03	0.79	17.
29	1.40	2.04	1.19	0.85	30.
30	2.10	3.14	0.0	3.14	172.
31	0.30	2.56	1.68	0.88	200.
Average		1.62	0.89	0.73	200.
Maximum		3.14	1.68	3.14	8.
Minimum		1.17	0.0	0.30	26.

TABLE 14
PRECIPITATION AND FLOW RECORDS FOR AUGUST, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1	1.85	3.97	0.70	3.27	253.
2		3.19	1.02	2.17	319.
3	0.19	2.14	1.59	0.55	315.
4	0.10	1.77	1.26	0.51	290.
5		1.99	1.16	0.83	244.
6		1.66	1.06	0.60	189.
7		1.64	1.15	0.49	127.
8		1.65	0.97	0.68	80.
9		1.65	0.90	0.75	49.
10		1.93	1.06	0.87	34.
11	0.05	1.93	1.02	0.91	26.
12		2.00	1.20	0.80	21.
13		1.64	0.76	0.88	18.
14		1.93	0.98	0.95	15.
15	0.25	1.64	0.72	0.92	15.
16		1.94	1.07	0.87	13.
17		1.62	0.87	0.75	12.
18		1.73	1.08	0.65	11.
19	0.55	1.83	1.00	0.83	14.
20		1.67	1.13	0.54	17.
21	0.05	1.86	0.77	1.09	14.
22		1.94	0.88	1.06	12.
23		1.94	1.02	0.92	10.
24		1.69	0.93	0.76	10.
25		1.52	0.92	0.60	9.
26		1.76	0.95	0.81	8.
27	9.31	5.48	0.20	5.28	276.
28		6.05	0.0	6.05	1085.
29		4.29	1.24	3.04	1311.
30		3.23	1.78	1.45	1305.
31		2.66	1.74	0.92	1215.
Average		2.32	1.00	1.32	236.
Maximum		6.05	1.78	6.05	1311.
Minimum		1.52	0.0	0.49	8.

TABLE 15

PRECIPITATION AND FLOW RECORDS FOR SEPTEMBER, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		2.65	1.76	0.89	1072.
2		2.28	1.68	0.60	904.
3		1.84	1.28	0.56	724.
4		1.48	0.96	0.52	558.
5		1.43	0.94	0.49	405.
6	1.00	1.94	1.09	0.85	269.
7		1.99	1.26	0.73	194.
8		1.91	0.97	0.94	171.
9	0.35	2.21	1.49	0.72	126.
10		2.10	1.22	0.88	83.
11	4.10	2.87	1.55	1.32	68.
12	1.65	6.12	0.85	5.27	618.
13	0.35	4.90	0.71	4.19	917.
14	0.05	4.17	0.65	3.52	1040.
15		2.81	1.82	0.99	1021.
16		2.39	1.65	0.74	976.
17	2.55	3.94	0.98	2.96	872.
18		4.33	0.40	3.93	820.
19		2.45	1.52	0.93	633.
20	0.20	1.77	1.11	0.66	520.
21		2.10	1.47	0.63	442.
22		1.94	1.44	0.50	370.
23		2.40	1.49	0.91	295.
24		2.34	1.49	0.85	216.
25		2.08	1.18	0.90	140.
26		1.92	1.06	0.86	102.
27		1.81	1.19	0.62	83.
28	0.10	1.75	1.16	0.59	72.
29		1.67	1.16	0.51	65.
30		1.72	1.21	0.51	60.
Average		2.51	1.22	1.29	461.
Maximum		6.12	1.82	5.27	1072.
Minimum		1.43	0.40	0.50	60.

TABLE 16
PRECIPITATION AND FLOW RECORDS FOR OCTOBER, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		2.13	1.26	0.87	54.
2	0.20	1.83	0.90	0.93	52.
3		1.77	0.90	0.87	48.
4		1.78	1.10	0.68	45.
5		1.71	1.11	0.60	42.
6		1.97	0.95	1.02	39.
7		1.60	0.91	0.69	37.
8		1.55	0.64	0.91	34.
9		2.00	1.05	0.95	31.
10	2.40	3.00	1.51	1.49	147.
11	0.05	2.78	1.78	1.00	289.
12		1.85	1.35	0.50	246.
13		1.94	1.36	0.58	196.
14		1.85	1.28	0.57	152.
15		1.78	1.26	0.53	131.
16		1.95	1.00	0.95	99.
17		1.91	0.99	0.92	76.
18		1.91	1.01	0.90	63.
19		2.05	1.00	1.05	54.
20		2.09	1.16	1.03	47.
21		1.70	0.91	0.79	43.
22		1.97	0.90	1.07	41.
23		1.50	0.82	0.68	38.
24	1.95	2.60	1.45	1.15	112.
25	0.15	3.27	1.80	1.47	273.
26		2.26	1.69	0.57	260.
27		1.99	1.44	0.55	225.
28		2.13	1.28	0.85	185.
29		2.03	1.27	0.76	146.
30		1.98	1.19	0.79	114.
31	0.15	1.72	1.00	0.72	92.
Average		2.02	1.17	0.85	110.
Maximum		3.27	1.80	1.49	289.
Minimum		1.50	0.64	0.50	31.

TABLE 17

PRECIPITATION AND FLOW RECORDS FOR NOVEMBER, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1	0.65	2.57	0.48	2.09	127.
2	0.30	3.74	0.0	3.74	259.
3	0.05	3.99	0.40	3.59	302.
4		2.75	0.39	2.36	330.
5		2.08	1.60	0.48	336.
6	0.35	1.88	1.40	0.40	313.
7		1.98	1.38	0.60	284.
8		1.96	1.48	0.48	242.
9		1.94	1.35	0.59	165.
10		1.78	1.30	0.48	136.
11		1.74	1.12	0.62	114.
12		1.77	1.28	0.49	99.
13		1.58	1.09	0.59	87.
14		1.55	1.07	0.48	78.
15	0.15	1.97	1.20	0.77	71.
16		1.86	1.19	0.67	69.
17		2.04	1.20	0.84	65.
18		1.95	1.24	0.71	60.
19	0.05	1.51	1.11	0.40	57.
20		1.74	1.10	0.64	55.
21		1.43	0.93	0.50	53.
22		1.84	0.95	0.89	51.
23		1.88	0.99	0.89	48.
24	1.50	2.09	1.38	0.71	45.
25	0.15	2.53	1.64	0.89	214.
26		2.38	1.60	0.78	273.
27	0.45	2.32	1.60	0.72	252.
28		2.39	1.64	0.75	276.
29	1.40	3.52	0.39	3.13	345.
30		3.18	0.0	3.18	450.
Average		2.20	1.08	1.12	175.
Maximum		3.99	1.64	3.74	450.
Minimum		1.43	0.0	0.40	45.

TABLE 18

PRECIPITATION AND FLOW RECORDS FOR DECEMBER, 1971

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		2.78	0.37	2.41	478.
2		2.00	1.52	0.48	425.
3		2.03	1.54	0.49	347.
4		1.71	1.19	0.52	264.
5		1.65	1.09	0.56	171.
6	0.65	2.09	1.37	0.72	130.
7	0.25	2.53	1.69	0.84	207.
8		2.36	1.66	0.70	230.
9		2.17	1.54	0.63	213.
10		2.34	1.47	0.87	187.
11		1.79	1.25	0.54	161.
12		1.71	1.11	0.60	133.
13		2.13	1.25	0.88	114.
14	0.05	1.83	1.22	0.61	100.
15	0.10	2.05	1.36	0.69	97.
16		1.85	1.27	0.58	99.
17		1.93	1.26	0.67	93.
18		1.59	0.99	0.60	84.
19	0.15	1.92	1.27	0.65	73.
20		1.73	1.20	0.53	67.
21		1.92	1.21	0.71	72.
22		1.74	1.11	0.63	69.
23		1.73	1.03	0.70	58.
24		1.74	1.15	0.69	56.
25		1.46	0.82	0.64	58.
26	0.05	1.74	1.10	0.64	57.
27		1.73	1.11	0.62	56.
28		1.67	1.09	0.58	55.
29		1.75	1.09	0.66	53.
30	1.00	1.83	1.19	0.64	67.
31		1.98	1.19	0.79	105.
Average		1.92	1.21	0.71	141.
Maximum		2.78	1.69	2.41	478.
Minimum		1.46	0.37	0.48	53.

TABLE 19
PRECIPITATION AND FLOW RECORDS FOR JANUARY, 1972

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow to Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		1.32	0.81	0.51	92.
2	1.40	2.20	1.31	0.89	130.
3		2.22	1.59	0.63	223.
4	0.45	2.16	1.42	0.74	198.
5	0.25	2.23	1.60	0.73	232.
6		2.23	1.45	0.78	207.
7		2.12	1.46	0.66	156.
8		1.80	1.23	0.57	123.
9	0.50	1.90	1.14	0.76	104.
10	0.05	2.74	1.29	1.45	207.
11	0.05	2.42	1.54	0.88	207.
12		2.14	1.51	0.63	190.
13	0.25	3.83	1.52	2.31	172.
14	0.08	2.21	1.52	0.69	172.
15		1.92	1.33	0.59	146.
16		1.77	1.16	0.71	94.
17		1.97	1.36	0.61	81.
18		1.97	1.29	0.68	79.
19		1.82	1.19	0.63	57.
20	0.05	1.78	1.24	0.54	59.
21		1.59	1.18	0.41	61.
22		1.42	1.04	0.38	61.
23	0.10	1.38	1.02	0.36	64.
24		1.82	1.25	0.57	76.
25		1.78	1.20	0.58	80.
26		1.68	1.10	0.58	68.
27	0.21	2.21	1.50	0.71	55.
28		1.65	1.10	0.55	47.
29		1.65	1.07	0.58	44.
30		1.58	1.04	0.54	45.
31		1.70	1.14	0.56	39.
Average		1.97	1.27	0.70	115.
Maximum		3.83	1.60	2.31	232.
Minimum		1.32	0.81	0.36	39.

TABLE 20

PRECIPITATION AND FLOW RECORDS FOR FEBRUARY, 1972

<u>Date</u>	<u>Rainfall (In Inches)</u>	<u>Flow in Plant (In MGD)</u>	<u>Flow to Summit (In MGD)</u>	<u>Flow to River (In MGD)</u>	<u>Passaic River Flow (In MGD)</u>
1		1.68	0.94	0.74	39.
2	0.05	1.88	1.43	0.45	38.
3	1.35	2.44	1.48	0.96	67.
4		2.78	1.71	1.07	256.
5		1.56	1.23	0.33	195.
6	0.35	1.70	1.24	0.46	169.
7		1.83	1.35	0.48	104.
8		1.87	1.27	0.60	96.
9		2.03	1.38	0.65	102.
10		1.65	1.22	0.43	74.
11		1.71	1.11	0.60	69.
12		1.59	1.03	0.56	45.
13	1.40	3.76	0.05	3.71	192.
14		2.82	1.47	1.35	358.
15		2.12	1.45	0.67	443.
16		2.34	1.66	0.68	417.
17		1.96	1.59	0.37	353.
18		1.79	1.28	0.65	268.
19	1.25	2.15	1.34	0.81	155.
20		1.81	1.43	0.38	116.
21		1.63	1.25	0.38	124.
22		1.79	1.28	0.51	106.
23	0.50	2.00	1.42	0.58	87.
24		1.65	1.26	0.39	72.
25		1.92	1.40	0.52	N/A
26		2.21	1.65	0.56	N/A
27		2.08	1.66	0.42	N/A
28		2.44	1.69	0.75	N/A
29		3.58	1.69	1.89	N/A
Average		2.10	1.34	0.76	164.
Maximum		3.76	1.71	3.71	443.
Minimum		1.56	0.05	0.33	38.

APPENDIX B
DRY WEATHER RESULTS

TABLE 21
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 1

Mode of Operation: Series
Time Period of Sampling: 7 AM on 3/18/71 - 7 AM on 3/19/71
Average Raw Sewage Flow: 2.0 MGD
Average Sewage Flow to Summit: 1.4 MGD
Average Flow Through Plant to Passaic River: 0.6 MGD
Average Flow to Filters: 1.4 MGD
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	Suspended Solids (MG/L)			BOD (5 Day 20° C.) (MG/L)		
	PE	PF	RF	PE	PF	RF
3/18/71 (7AM-1PM)	61	66	94	66	28	28
3/18/71 (1PM-7PM)	124	87	72	117	39	27
3/18/71-3/19/71 (7PM - 1AM)	64	73	139	81	41	35
3/19/71 (1AM-7AM)	114	72	47	159	44	27
AVG.	91	75	88	100	38	29

Date & Time	NH ₃ -N (MG/L)			NO ₂ -N (MG/L)			NO ₃ -N (MG/L)			Total-P (MG/L)		
	PE	PF	RF	PE	PF	RF	PE	PF	RF	PE	PF	RF
3/18/71-3/19/71 (7AM - 7AM)	22	17	22	.34	.26	.27	1.4	.18	.07	1.3	1.3	1.3

TABLE 22
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 2

Mode of Operation: Series
Time Period of Sampling: 8 AM on 4/22/71 - 8 AM on 4/23/71
Average Raw Sewage Flow: 1.8 MGD
Average Sewage Flow to Summit: 1.3 MGD
Average Flow Through Plant to Passaic River: 0.5 MGD
Average Flow to Filters: 1.3 MGD
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	PH			Suspended Solids (MG/L)			BOD (5 Day 20° C.) (MG/L)		
	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF
4/22/71 (8AM-2PM)	7.5	7.8	8.0	8.1	8.0	8.1	206	113	58
4/22/71 (2PM-8PM)	7.6	8.0	8.1	8.5	8.6	8.6	149	95	74
4/22/71-4/23/71 (8PM - 2AM)	7.5	8.0	8.1	8.5	8.5	8.5	142	81	62
4/23/71 (2AM-8AM)	7.8	8.0	8.0	8.2	8.2	8.2	-	51	56
AVG.			166	85	63	75	20	178	117
Date & Time	NH ₃ -N (MG/L)			NO ₂ -N (MG/L)			NO ₃ -N (MG/L)		
	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF
29	29	33	35	29	.12	.42	.85	.71	.82
(8AM-8AM)							Total-P (MG/L)		
							Raw	PE	PF
							1.1	1.2	.9
							1.1	1.2	.9
							1.0		

TABLE 23
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 3

Mode of Operation: Series
Time Period of Sampling: 7 AM on 8/25/71 - 7 AM on 8/26/71
Average Raw Sewage Flow: 1.4 MGD
Average Sewage Flow to Summit: 0.9 MGD
Average Flow Through Plant to Passaic River: 0.5 MGD
Average Flow to Filters: 1.3 MGD
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	PH			Suspended Solids (MG/L)			BOD (MG/L)		
	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF
8/25/71 (7AM-1PM)	7.58	7.04	7.48	7.52	7.57	7.57	132	72	22
8/25/71 (1PM-7PM)	5.33	6.59	7.40	7.53	7.57	7.57	166	112	62
8/25/71-8/26/71 (7PM - 1AM)	6.81	6.90	7.41	7.48	7.60	7.60	148	110	58
8/26/71 (1AM-7AM)	7.18	7.07	7.62	7.52	7.59	7.59	172	148	52
	AVG. 171			126	61	32	20	193	126
	NO ₂ -N (MG/L)			NO ₃ -N (MG/L)					
	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF
8/25/71-3/26/71 (7AM - 7AM)	37	32	19	21	19	.03	.44	.50	.40
	.01			.01	.01	.42	.83	.61	4.5
	Total-P (MG/L)			Raw	PE	PF	Raw	PE	PF
	37	32	19	21	19	.03	.44	.50	.40
	.01			.01	.01	.42	.83	.61	4.5
	4.1			3.4	2.6	1.5			

TABLE 24
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 4

Mode of Operation: Series
Time Period of Sampling: 9 PM on 11/5/71 - 9 PM on 11/12/71
and 9 AM on 11/15/71 - 9 PM on 11/17/71
Average Raw Sewage Flow: 1.6 MGD
Average Sewage Flow to Summit: 1.0 MGD
Average Flow Through Plant to Passaic River: 0.6 MGD
Average Flow to Filters: 1.4 MGD
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	PH			Suspended Solids (MG/L)						BOD (MG/L)					
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
11/5/71-11/6/71 (9PM - 9AM)	6.8	6.9	7.1	7.3	7.3	114	50	40	50	25	76	83	23	24	13
11/6/71 (9AM-9PM)	7.0	7.4	7.2	7.2	7.5	105	78	34	31	30	155	96	23	34	20
11/6/71-11/7/71 (9PM - 9AM)	6.3	7.4	7.1	7.4	-	34	39	23	46	12	106	94	28	30	22
11/7/71 (9AM-9PM)	7.0	7.1	7.0	7.3	7.5	270	65	46	40	8	220	67	20	20	8
11/7/71-11/8/71 (9PM - 9AM)	7.3	7.4	7.2	7.4	7.5	197	42	26	52	16	69	60	23	23	11
11/8/71 (9AM-9PM)	7.2	7.5	7.4	7.4	8.0	173	99	48	51	15	136	99	30	27	10
11/8/71-11/9/71 (9PM - 9AM)	7.2	7.3	7.4	7.4	7.5	39	59	39	36	98	78	68	30	22	35

TABLE 24 (Continued)
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 4

Date & Time	FH			Suspended Solids (MG/L)			BOD (MG/L)		
	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF
11/9/71 (9AM-9PM)	7.2	7.4	7.4	7.4	7.4	7.5	143	118	39
11/9/71-11/10/71 (9PM - 9AM)	7.2	7.6	7.3	7.6	7.8	7.8	89	76	34
11/10/71 (9AM-9PM)	6.8	7.2	7.2	7.2	7.5	7.5	122	93	40
11/10/71-11/11/71 (9PM - 9AM)	6.9	7.0	7.0	7.0	7.2	7.2	199	70	48
11/11/71 (9AM-9PM)	7.2	7.4	7.4	7.9	7.9	7.9	171	131	56
11/11/71-11/12/71 (9PM - 9AM)	7.4	7.4	7.6	7.6	7.6	7.6	155	85	40
11/12/71 (9AM-9PM)	6.9	7.4	7.5	7.5	7.6	7.6	299	92	38
11/15/71 (9AM-9PM)	7.0	7.3	7.5	7.6	7.5	7.5	243	101	38
11/15/71-11/16/71 (9PM - 9AM)	7.4	7.4	7.3	7.4	7.6	7.6	150	90	32
11/16/71 (9AM-9PM)	8.6	8.2	7.5	7.4	7.6	7.6	168	113	32

TABLE 24 (Continued)
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 4

Date & Time	PH					Suspended Solids (MG/L)					BOD (MG/L)				
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
11/16/71-11/17/71 (9PM - 9AM)	7.1	8.0	7.7	7.8	7.9	89	62	56	32	8	129	103	28	26	15
11/17/71 (9AM-9PM)	7.2	7.1	7.4	7.8	7.2	231	124	47	29	7	159	87	34	27	-
AVG.															
						142	70	45	45	21	150	91	33	29	18

Date & Time	NH ₃ -N (MG/L)					NO ₂ -N (MG/L)					NO ₃ -N (MG/L)					Total-P (MG/L)				
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
11/5/71-11/6/71 (9PM - 9PM)	13.0	11.5	2.5	1.3	3.0	-	-	.70	.48	.20	-	-	8.0	5.0	8.4	2.9	3.2	3.3	3.5	3.4
11/6/71-11/7/71 (9PM - 9PM)	8.0	11.3	0.1	3.0	.6	-	-	.78	.70	.50	.25	.15	10.0	10.5	10.3	2.3	2.5	2.7	2.9	2.2
11/7/71-11/8/71 (9PM - 9PM)	11.0	11.6	3.7	7.0	1.5	.19	.01	.90	.62	.55	.04	.14	4.6	5.4	5.0	3.4	1.8	1.4	2.9	1.7
11/8/71-11/9/71 (9PM - 9PM)	-	10.0	3.0	2.9	2.3	.01	.03	.70	.52	.52	-	.10	8.5	9.6	9.6	1.6	2.6	3.1	1.3	2.0
11/9/71-11/10/71 (9PM - 9PM)	-	12.0	5.0	4.0	5.0	.13	.27	.98	.44	.42	-	.75	7.9	9.6	8.5	3.3	1.6	2.7	2.6	1.9
11/10/71-11/11/71 (9PM - 9PM)	-	13.5	13.0	6.0	2.0	.07	.23	.98	.57	.44	-	.66	7.9	9.6	9.6	1.5	2.2	1.3	1.2	1.3

TABLE 25
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 5

Mode of Operation: Series
Time Period of Sampling: 5 PM on 12/2/71 - 5 PM on 12/5/71
Average Raw Sewage Flow: 1.8 MGD
Average Sewage Flow to Summit: 1.3 MGD
Average Flow Through Plant to Passaic River: 0.5 MGD
Average Flow to Filters: 1.3 MGD
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	PH				Suspended Solids (MG/L)						BOD (5 Day 20° C.)					
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	FE
12/2/71-12/3/71 (5PM - 5AM)	7.2	7.4	7.5	7.6	7.9	160	101	17	23	11	152	93	20	12	11	
12/3/71 (5AM-5PM)	7.3	7.5	7.6	7.7	7.8	111	60	29	23	18	110	95	29	22	-	
12/3/71-12/4/71 (5PM - 5AM)	7.6	7.5	7.7	7.9	8.0	116	47	37	24	12	122	103	34	25	27	
12/4/71 (5AM-5PM)	7.2	7.4	7.5	7.7	7.9	114	49	23	23	12	-	-	-	-	-	
12/4/71-12/5/71 (5PM - 5AM)	-	7.4	7.5	7.6	7.6	-	47	23	20	12	-	117	44	31	17	
12/5/71 (5AM-5PM)	7.4	7.8	7.8	7.9	8.0	182	48	39	27	8	214	74	40	12	20	
AVG. 137 59 27 23 12 150 95 33 20 19																

TABLE 25 (Continued)
RESULTS OF SAMPLING AND ANALYSIS OF DRY WEATHER EPISODE NO. 5

Date & Time	NH ₃ -N (MG/L)						NO ₂ -N (MG/L)						NO ₃ -N (MG/L)						Total-P (MG/L)					
	Raw	PE	PF	RF	FE	FE	Raw	PE	PF	RF	FE	FE	Raw	PE	PF	RF	FE	FE	Raw	PE	PF	RF	FE	FE
12/2/71-12/3/71 (5PM-5PM)	9	13	7	2	5		.03	.07	.42	.29	.27		.46	1.01	10.0	11.0	11.2		2.6	2.7	2.7	2.6	1.9	
12/3/71-12/4/71 (5PM-5PM)	14	13	5	6	6		.05	.15	.52	.38	.29		.26	.76	11.4	14.0	11.7		2.7	3.2	3.1	2.6	2.6	
12/4/71-12/5/71 (5PM-5PM)	39	21	12	14	13		.01	.01	.75	.58	.42		.06	.03	13.0	14.5	13.4		3.1	2.5	2.4	3.0	3.0	
AVG.	21	16	8	7	8		.03	.07	.56	.42	.33		.25	.60	11.5	13.2	12.1		2.8	2.8	2.7	2.7	2.8	

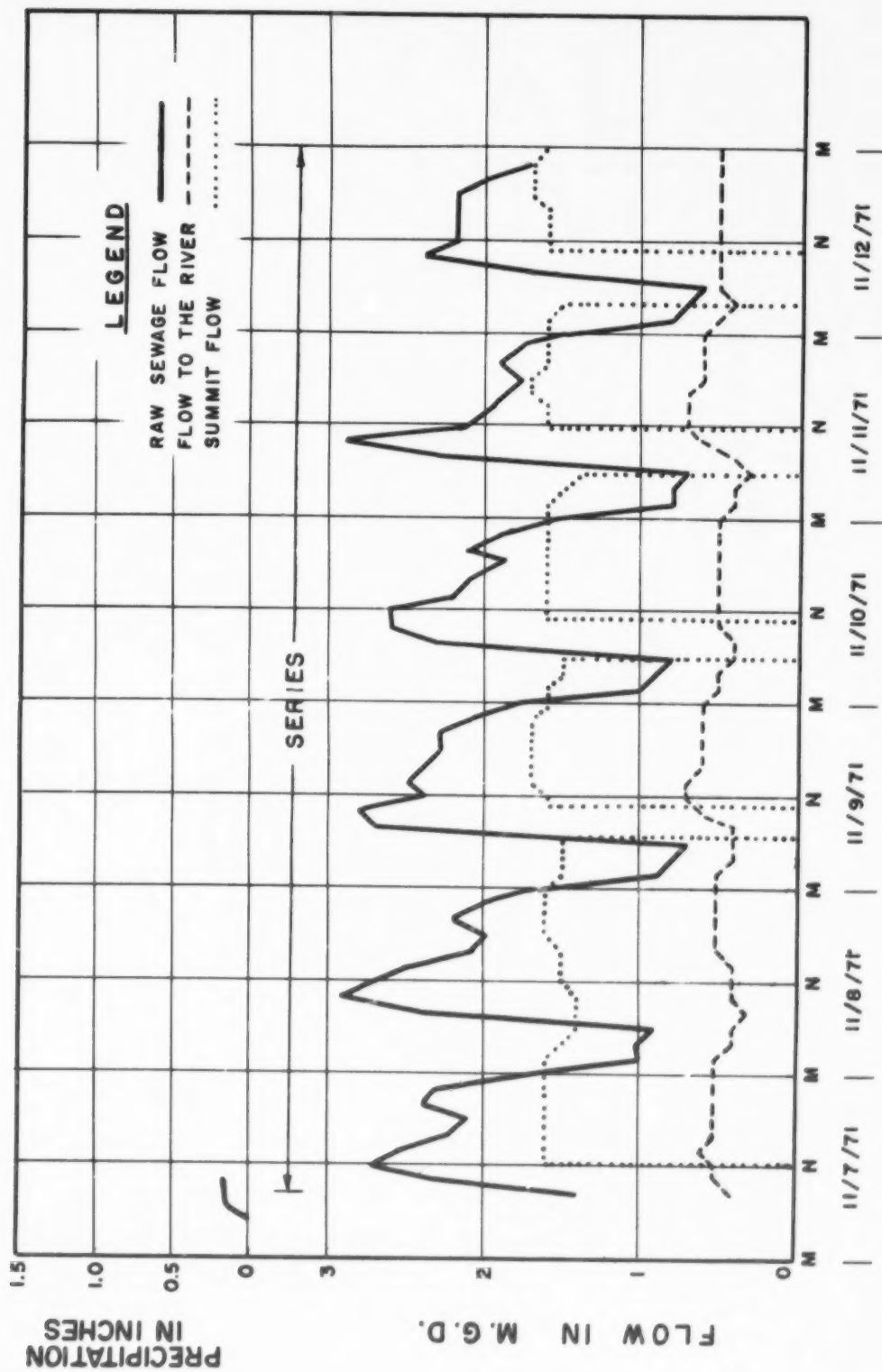


FIGURE 21
TYPICAL DRY WEATHER FLOW

APPENDIX C
WET WEATHER RESULTS

TABLE 26
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 1

Mode of Operation: Parallel
Time Period of Parallel Operation: 10 AM on 4/7/71 - 11 AM on 4/9/71 Average Precipitation: 2.70 Inches
Time Period of Sampling: 7 AM on 4/7/71 - 7 AM on 4/9/71 Duration: From 3 PM on 4/6/71
Average Raw Sewage Flow: 4.8 MGD To 1 PM on 4/7/71
Average Sewage Flow to Summit: 0.2 MGD
Average Flow Through Plant to Passaic River: 4.6 MGD
Average Flow to Filters (As Shown in Table)
Nature of Sample: Composited on Dates and Over Time Period Shown

Date & Time	Flow (MGD)		PH			Suspended Solids (MG/L)						BOD (MG/L)		
	Rock	Plastic	PE	PF	RF	PE	PF	RF	FE	PF	FE	PE	PF	FE
4/7/71 (7AM-1PM)	3.00	3.00	7.6	7.7	7.7	7.6	7.4	126	69	46	76	44	53	36
4/7/71 (1PM-7PM)	3.10	3.10	7.5	7.5	7.6	8.0	40	30	8	34	58	33	45	39
4/7/71-4/8/71 (7PM - 1AM)	2.60	2.60	7.4	7.8	7.8	7.8	67	108	78	67	60	46	67	60
4/8/71 (1AM-7AM)	1.80	1.80	7.4	7.8	7.6	7.9	28	56	45	39	30	31	39	43
4/8/71 (7AM-1PM)	2.20	2.20	7.4	7.9	7.7	7.8	31	67	46	25	44	57	30	20
4/8/71 (1PM-7PM)	2.20	2.20	8.0	7.5	7.5	7.9	-	55	54	35	33	38	57	47
4/8/71-4/9/71 (7PM - 1AM)	2.00	2.00	7.3	7.6	7.6	7.7	41	42	7	25	82	51	67	54
4/9/71 (1AM-7AM)	1.50	1.50	7.3	7.8	7.8	7.8	45	20	21	20	65	32	41	44
AVG. 36 62 43 39 57 42 51 43														

TABLE 26 (Continued)
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 1

Date & Time	NH ₃ -N (MG/L)			NO ₂ -N (MG/L)			NO ₃ -N (MG/L)			Total-P (MG/L)		
	PE	PF	RF	FE	PE	PF	RF	FE	PE	PF	RF	FE
4/7/71-4/8/71 (7AM - 7AM)	16.2	9.1	11.6	11.6	0	.20	.19	.18	.78	.72	.52	.68
4/8/71-4/9/71 (7AM - 7AM)	9.5	1.8	4.0	.9	.65	.70	.72	.45	.85	.92	.88	.92
AVG.	13.4	6.0	8.3	7.0	.27	.41	.41	.30	.81	.81	.67	.18
										.18	.35	.37
										.17	.40	.48
												.10
										.19	.28	.23
												.34

PRECIPITATION IN INCHES

FLOW IN M.G.D.

LEGEND

- RAW SEWAGE FLOW (solid line)
- FLOW TO THE RIVER (dashed line)
- SUMMIT FLOW (dotted line)

PARALLEL

1:1 FLOW SPLIT PLASTIC TO ROCK

4/6/71 4/7/71 4/8/71 4/9/71 4/10/71

FIGURE 22
PRECIPITATION & PLANT FLOW VS TIME

TABLE 27
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 2

Mode of Operation: Parallel

Time Period of Parallel Operation: 1 PM-5/13/71-7 AM-5/14/71

Time Period of Sampling: 1 PM on 5/13/71 - 1 PM on 5/14/71

Average Raw Sewage Flow: 3.00 MGD

Average Sewage Flow to Summit: 0.00 MGD

Average Flow Through Plant to Passaic River: 3.00 MGD

Average Flow to Filters (As Shown in Table)

Nature of Sample: Compositied on Dates and Over Time Period Shown

Average Precipitation: 1.1 Inches
Duration: From 5 AM on 5/13/71
To 10 PM 5/13/71

Date & Time	Flow (MGD)		PH		Suspended Solids (MG/L)						BOD (MG/L)					
	Rock	Plas- tic	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	FE
5/13/71 (1PM-7PM)	1.1	2.3	8.1	8.0	8.2	8.3	8.3	110	79	101	111	39	108	100	62	66
5/13/71-5/14/71 (7PM - 1AM)	1.2	2.0	8.1	8.2	8.3	8.6	8.4	164	107	120	124	54	162	128	108	105
(1AM-6AM)	1.0	1.3	7.9	8.1	8.2	8.2	8.4	-	64	72	93	50	260	106	58	98
								AVG.	135	85	100	110	47	168	152	77
5/14/71* (6AM-1PM)	1.5	1.5	7.8	8.2	8.2	8.2	8.2	117	85	49	58	41	108	82	31	21
Date & Time	NH ₃ -N (MG/L)		NO ₂ -N (MG/L)				NO ₃ -N (MG/L)				Total-P (MG/L)					
	Raw	PE	PF	RF	FE	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
5/13/71-4/14/71 (1PM - 1PM)	23.6	25.6	30.2	25.0	25.6	.08	.45	.59	.80	-	.71	2.4	3.0	3.1	2.9	2.4

*Plant reverted to series operation at 6 AM on 5/14/71

NOTE: DURING PARALLEL OPERATION THE RAW SEWAGE FLOW AND THE FLOW TO THE RIVER ARE EQUAL.

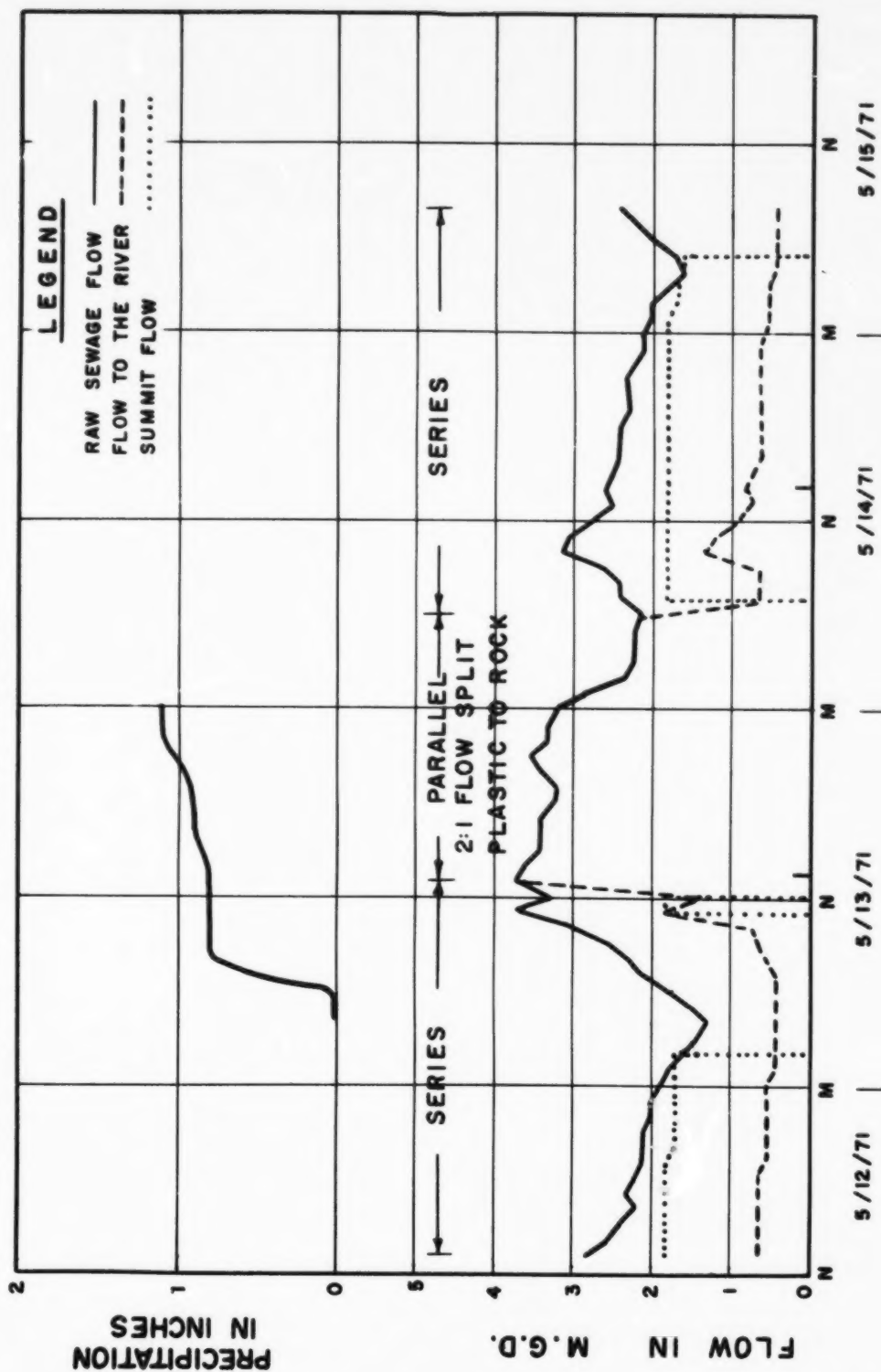


FIGURE 23
PRECIPITATION & PLANT FLOW VS. TIME

TABLE 28

Mode of Operation: Parallel

Flow (MGD)

TABLE 28
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 3
(Continued)

Date & Time	Flow (MGD)		PH					Suspended Solids (MG/L)					BOD (MG/L)							
	Rock	Plas- tic	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE			
8/29/71 (3AM-9AM)	4.0	0.3	-	-	-	-	-	113	30	76	19	23	38	17	31	11	15			
								79	80	61	34	35	67	63	42	39	29			
								AVG.												
								AVG.												
Date & Time	NH ₃ -N (MG/L)					NO ₂ -N (MG/L)					NO ₃ -N (MG/L)					Total-P (MG/L)				
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
8/27/71-8/28/71 (9AM - 9AM)	7.4	8.1	7.4	9.2	8.1	.02	.56	.58	.47	.54	.08	.14	.97	.95	1.7	1.1	1.0	1.4	1.0	1.1
8/28/71-8/29/71 (9AM - 9AM)	7.0	6.5	4.5	11.2	14.0	.04	.03	.04	.04	.02	.16	.44	.54	.49	1.1	1.1	1.0	1.0	1.5	1.4
AVG. 7.2	7.3	6.0	10.2	11.2	.03	.28	.33	.24	.27	.12	.30	.83	.70	1.4	1.1	1.0	1.2	1.3	1.2	

*Plant was in series from 9 AM - 11 AM on 8/27/71

NOTE: DURING PARALLEL OPERATION THE RAW SEWAGE FLOW AND THE FLOW TO THE RIVER ARE EQUAL.

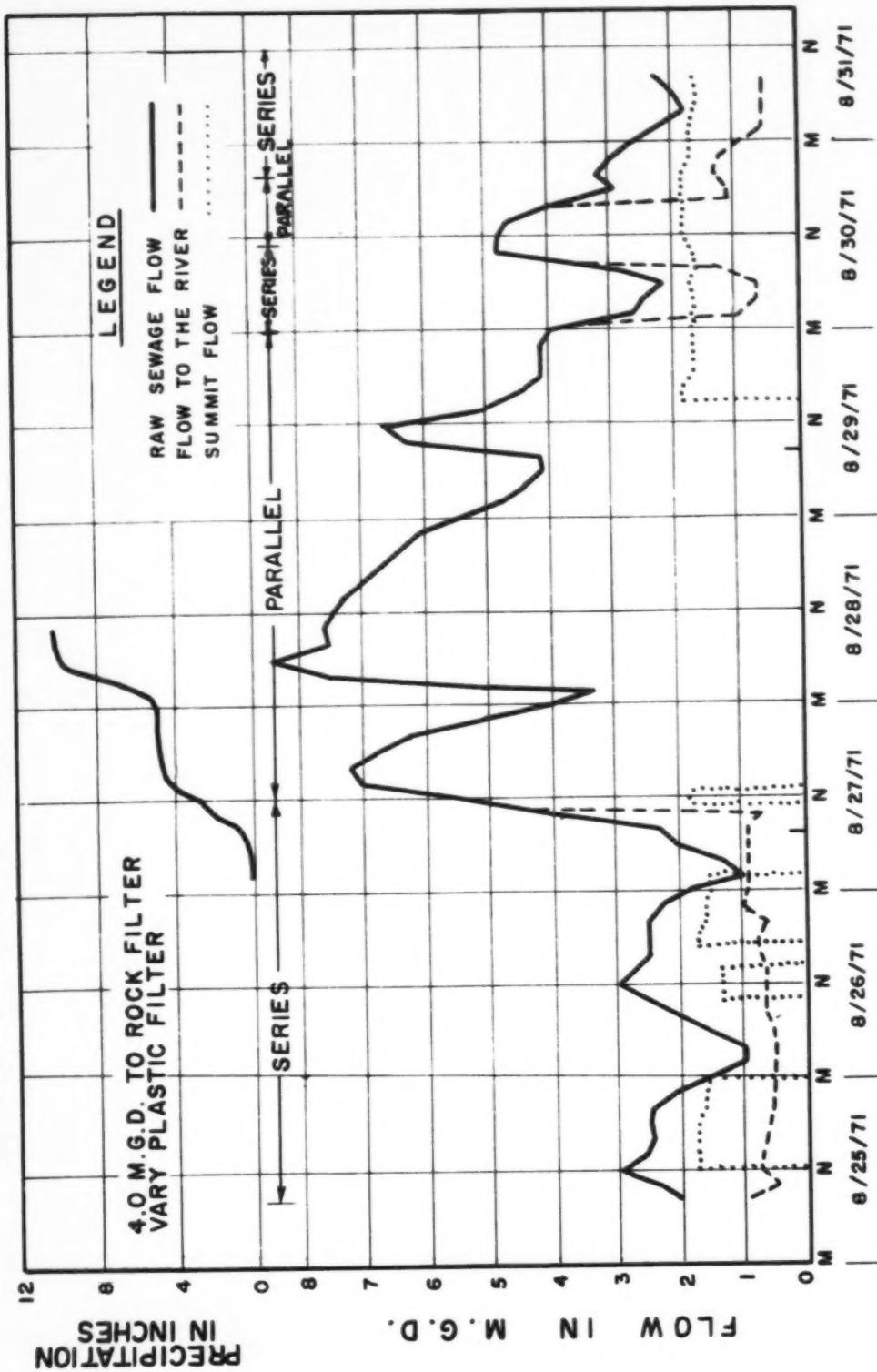


FIGURE 24
PRECIPITATION & PLANT FLOW VS. TIME

TABLE 28
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 4

Mode of Operation: Parallel

Time Period of Parallel Operation: 4 AM-9/12/71-11 PM-9/14/71

Average Precipitation: 5.0 inches

Time Period of Sampling: 5 PM on 9/13/71 - 5 PM on 9/14/71

Average Raw Sewage Flow: 4.7 MGD

Duration: From 7 AM on 9/11/71

To Noon on 9/13/71

Average Sewage Flow to Summit: 0.07 MGD

Average Flow Through Plant to Passaic River: 4.63 MGD

Average Flow to Filters (As Shown in Table)

Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	Flow (MGD)		PH					Suspended Solids (MG/L)					BOD (MG/L)							
	Rock	Plas- tic	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE			
9/13/71 (5PM-11PM)	2.7	2.7	-	6.5	7.2	6.8	6.9	116	39	48	54	34	96	54	43	48	33			
9/13/71-9/14/71 (11PM - 5AM)	2.1	2.1	6.7	6.7	6.9	6.8	7.0	77	18	32	13	8	-	37	36	21	19			
9/14/71 (5AM-11AM)	2.1	2.1	7.0	6.4	7.0	6.7	6.7	132	33	33	26	32	130	40	15	17	12			
9/14/71 (11AM-5PM)	2.5	2.5	6.9	6.4	7.0	6.7	6.7	106	80	42	-	17	99	82	55	48	38			
	AVG. 108 51 39 33 23 107 57 39 35 27																			
Date & Time	NH ₃ -N (MG/L)					NO ₂ -N (MG/L)					NO ₃ -N (MG/L)					Total-P (MG/L)				
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
9/13/71-9/14/71 (5PM - 5 PM)	1.5	1.8	2.5	3.5	2.5	.11	.16	.20	.16	.23	.19	.18	.44	.65	.42	1.4	1.5	1.3	1.6	1.5

NOTE: DURING PARALLEL OPERATION THE RAW SEWAGE FLOW AND THE FLOW TO THE RIVER ARE EQUAL.

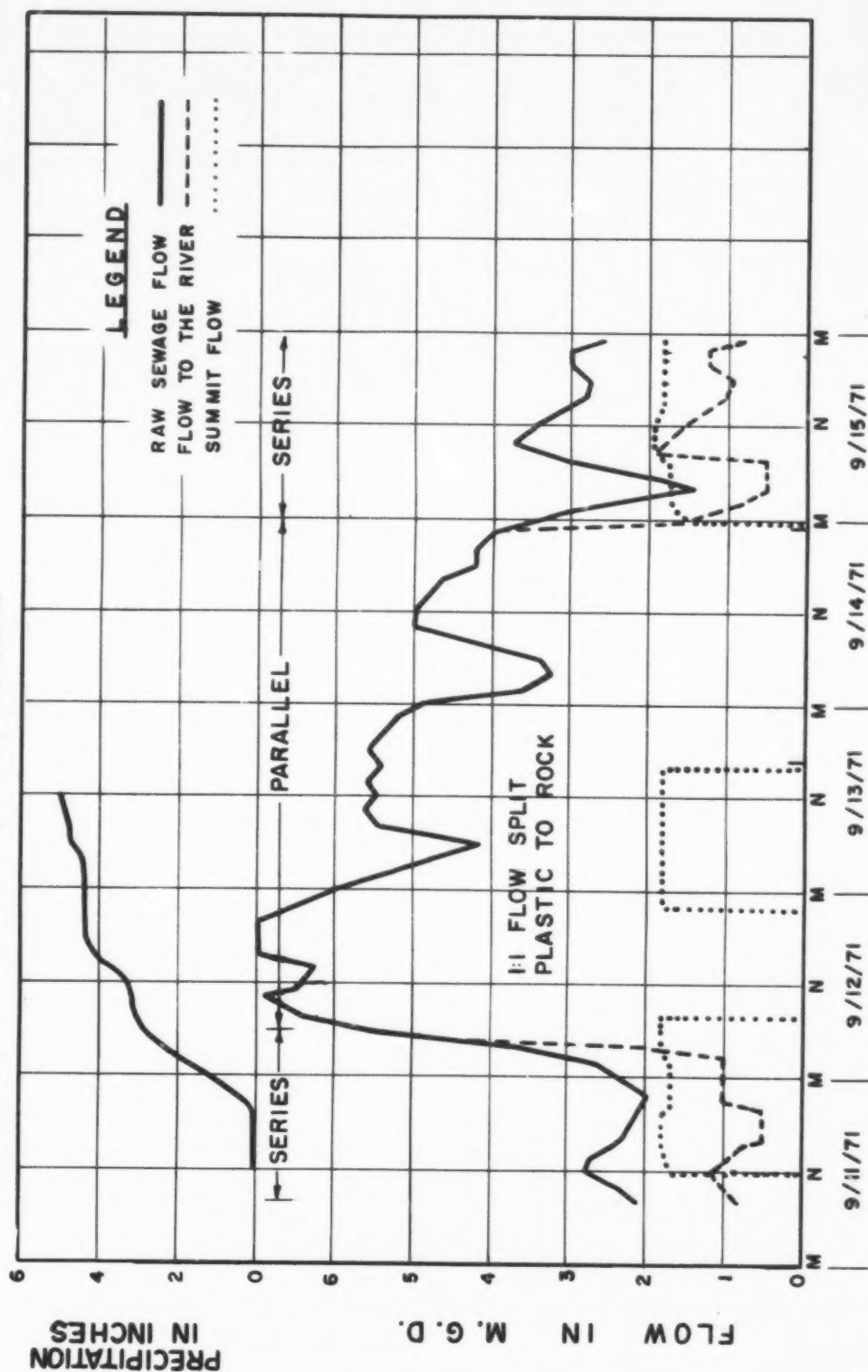


FIGURE 25
PRECIPITATION & PLANT FLOW VS. TIME

TABLE 30

Mode of Operation: Parallel

Time Period of Parallel Operation

Time Period of Sampling: 4:30

Average Raw Sewage Flow: 3.1

Average Sewage Flow to Summit

Average Flow Through Plant to

Average Flow to Filters: (As

Nature of Sample: Composites

Date & Time	Flow (MGD)		Suspended Solids (MG/L)																BOD (MG/L)											
	Rock	Plas- tic	PH				Raw				PF				RF				Raw				PF				RF			
			Raw	PE	PF	RF	Raw	PE	PF	RF	Raw	PE	PF	RF	Raw	PE	PF	RF	Raw	PE	PF	RF	Raw	PE	PF	RF				
11/1/71 (4:30PM-10:30PM)	1.4	2.4	7.0	7.2	7.4	7.4	7.4	159	94	55	54	34	123	125	43	50	35													
11/1/71-11/2/71 (10:30PM-4:30AM)	0.9	1.7	7.0	7.1	7.3	7.3	7.5	67	43	42	47	25	53	67	54	46	33													
11/2/71 (4:30AM-10:30AM)	1.1	2.2	7.3	7.1	7.5	7.4	7.2	284	27	39	24	19	187	44	39	35	26													
11/2/71 (10:30AM-4:30PM)	1.4	2.7	7.2	7.4	7.6	7.6	7.7	178	55	55	79	24	122	76	44	45	39													
11/2/71 (4:30PM-10:30PM)	1.4	2.8	6.9	7.2	7.5	7.5	7.6	104	40	43	31	32	99	72	51	42	33													
11/2/71-11/3/71 (10:30PM-4:30AM)	1.0	2.1	6.9	7.0	7.4	7.4	7.6	60	37	35	26	31	90	114	56	37	35													
11/3/71 (4:30AM-10:30AM)	1.1	2.3	7.2	7.2	7.6	7.6	7.6	50	24	33	29	20	42	30	31	24	28													

TABLE 30
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 5
(Continued)

Date & Time	Flow (MGD)		PH						Suspended Solids (MG/L)						BOD (MG/L)					
	Rock	Plastic	Raw		PF		RF		Raw		PF		RF		Raw		PF		RF	
			PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE
11/3/71* (10:30AM-4:30PM)	1.8	2.6	7.5	7.7	8.0	8.3	8.0	131	43	47	30	24	149	85	46	43	29			
11/3/71-11/4/71 (9PM - 9AM)	1.0	2.0	7.4	7.1	7.4	7.5	7.7	173	40	26	21	21	129	87	42	33	41			
11/4/71 (9AM-9PM)	1.2	2.4	7.0	7.3	7.4	7.6	7.8	223	53	43	26	18	119	93	36	57	40			
11/4/71-11/5/71** (9PM - 9AM)	1.1	1.4	6.6	6.6	7.0	7.1	7.2	316	63	20	44	22	212	-	35	38	40			
11/5/71 (9AM-9PM)	1.3	1.3	6.8	7.1	7.4	7.4	7.7	424*	127	38	42	39	174	101	23	31	19			
								AVG. 170	48	42	38	25	122	78	43	41	34			

*Filters reverted to series operation from 2 PM on 11/3/71 - 9 PM on 11/3/71

**Filters reverted to and continued to operate in series from 2 AM on 11/5/71

Date & Time	NH ₃ -N (MG/L)						NO ₂ -N (MG/L)						NO ₃ -N (MG/L)						Total-P (MG/L)					
	Raw		PE		PF		Raw		PE		RF		Raw		PE		RF		Raw		PE		RF	
	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE	PE	FE
11/1/71-11/2/71 (4:30AM-4:30PM)	14.5	10.0	9.4	9.0	10.0	.15	.03	.38	.23	.31	.80	3.9	4.7	3.2	4.9	2.1	2.4	2.5	4.7	2.6				
11/2/71-11/3/71 (4:30PM-4:30PM)	9.5	6.8	6.0	5.8	6.8	.19	.07	.38	.29	.38	1.1	.2	4.2	4.1	4.8	2.4	3.0	3.0	3.0	3.0				

TABLE 30
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 5
(Continued)

Date & Time	NH ₃ -N (MG/L)			NO ₂ -N (MG/L)			NO ₃ -N (MG/L)			Total-P (MG/L)										
	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE					
11/3/71-11/4/71 (9PM - 9PM)	10.8	10.0	8.0	9.5	7.4	-	-	.47	.38	.34	.25	-	1.2	.4	2.5	3.0	2.5	3.0	2.2	
11/4/71-11/5/71 (9PM - 9PM)	13.0	10.0	2.0	3.2	4.1	.01	-	.11	.11	.17	-	-	1.0	1.2	1.1	2.6	3.4	3.5	2.7	2.9
AVG.	11.8	9.0	7.1	7.3	7.8	.13	.05	.38	.27	.33	.73	2.0	3.2	2.5	3.9	2.4	2.8	2.8	2.6	2.6

NOTE : DURING PARALLEL OPERATION THE RAW SEWAGE FLOW AND THE FLOW TO THE RIVER ARE EQUAL.

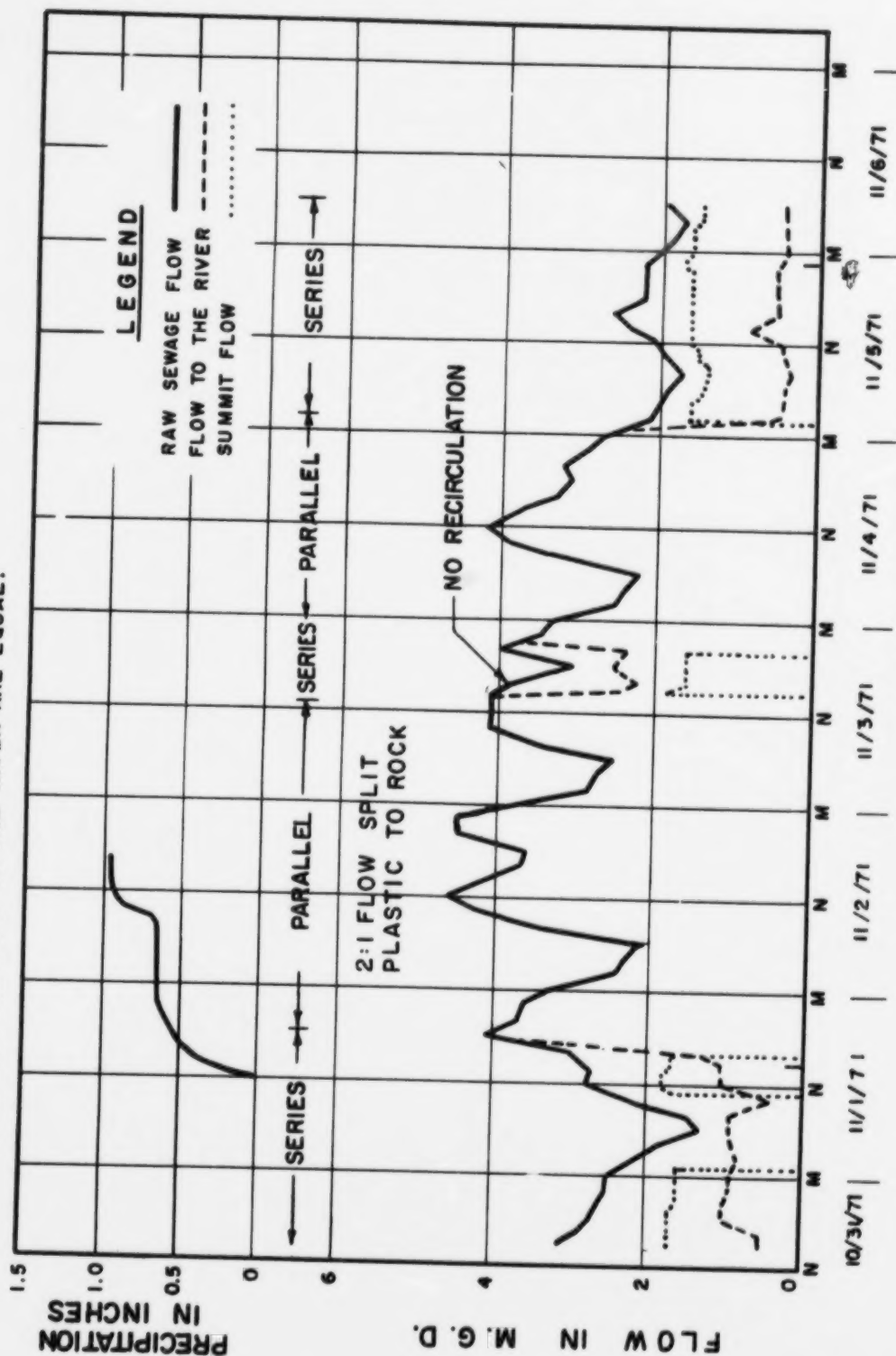


FIGURE 26
PRECIPITATION & PLANT FLOW VS. TIME

TABLE 31

Mode of Operation: Parallel

Time Period of Parallel Operation: 7 PM on 11/29/71 - 3 AM on 12/2/71

Time Period of Sampling: 5 PM on 11/29/71 - 5 PM on 12/2/71

Average Raw Sewage Flow: 3.4 MGD

Average Sewage Flow to Summit: 0.40 MGD

Average Flow Through Plant to Passaic River: 3.00 MGD

Average Flow to Filters (As Shown in Table)

Nature of Sample: Composited on Dates and Over Time Period Shown

Date & Time	Flow (MGD)		PH			Suspended Solids (MG/L)			BOD (MG/L)			
	Rock	Plas- tic	Raw	PE	PF	Raw	PE	PF	Raw	PE	PF	
11/29/71* (5PM-11PM)	1.7	3.9	7.3	7.9	7.8	7.5	117	114	58	145	105	44
11/29/71-11/30/71 (11PM - 5AM)	1.1	3.5	7.1	7.5	7.4	7.6	64	39	61	47	50	33
11/30/71 (5AM-11AM)	1.0	3.1	7.3	7.5	7.7	7.8	7.6	77	27	22	35	26
11/30/71 (11AM-5PM)	1.0	3.3	7.0	7.3	7.7	7.5	7.4	97	54	54	43	44
11/30/71 (5PM-11PM)	0.9	2.9	7.0	7.4	7.5	7.6	7.6	82	57	35	49	48
11/30/71-12/1/71 (11PM - 5AM)	0.8	2.2	7.0	7.1	6.9	-	7.0	94	42	42	51	49
12/1/71 (5AM-11AM)	1.0	2.3	6.9	7.1	7.2	7.3	7.0	114	33	28	46	35

TABLE 31
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 6
(Continued)

Date & Time	Flow (MGD)		PH			Suspended Solids (MG/L)						BOD (MG/L)					
	Rock	Plastic	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE	Raw	PE	PF	RF	FE
12/1/71 (11AM-5PM)	1.0	2.4	7.2	7.5	7.5	7.6	7.8	64	60	36	22	42	122	86	37	25	41
12/1/71 (5PM-11PM)	1.1	2.2	6.7	6.5	7.0	7.0	7.1	323	47	46	34	45	188	104	44	43	31
12/1/71-12/2/71** (11PM - 5AM)	1.0	1.5	7.3	7.2	7.2	7.5	7.4	28	37	63	39	45	33	119	25	35	42
12/2/71 (5AM-5PM)	1.3	1.3	7.5	7.6	7.6	7.8	7.6	101	117	49	49	63	130	114	44	30	30
			AVG.			110			54			42			51		

*Filters were operating in series from 5 PM - 7 PM on 11/29/71
 **Filters reverted to series operation at 3 AM on 12/2/71

Date & Time	NH ₃ -N (MG/L)					NO ₂ -N (MG/L)					NO ₃ -N (MG/L)					Total-P (MG/L)													
	Raw		PE		PF	RF		FE	Raw		PE		PF	RF		FE	Raw		PE		PF	RF		FE					
11/29/71-11/30/71 (5PM - 5PM)	6.8	3.8	5.5	5.5	5.0					.14	.18	.27	.24	.26				1.7	1.8	5.8	6.5	7.7			1.8	1.4	1.6	1.1	1.6
11/30/71-12/1/71 (5PM - 5PM)	7.0	6.5	5.8	5.5	7.5					.52	.20	.40	.29	.29				1.0	1.5	4.2	4.5	4.5			2.4	1.9	3.1	1.8	1.2
12/1/71-12/2/71 (5PM - 5PM)	9.4	13.5	11.5	5.0	9.0					.19	.20	.61	.29	.36				-	-	-	-	-			2.2	3.3	1.8	1.8	1.6
AVG.	7.5	7.1	7.1	5.4	6.8					.13	.19	.40	.27	.30				1.4	1.7	5.1	5.7	6.4			3.1	2.2	2.2	1.2	1.5

NOTE : DURING PARALLEL OPERATION THE RAW SEWAGE FLOW AND THE FLOW TO THE RIVER ARE EQUAL.

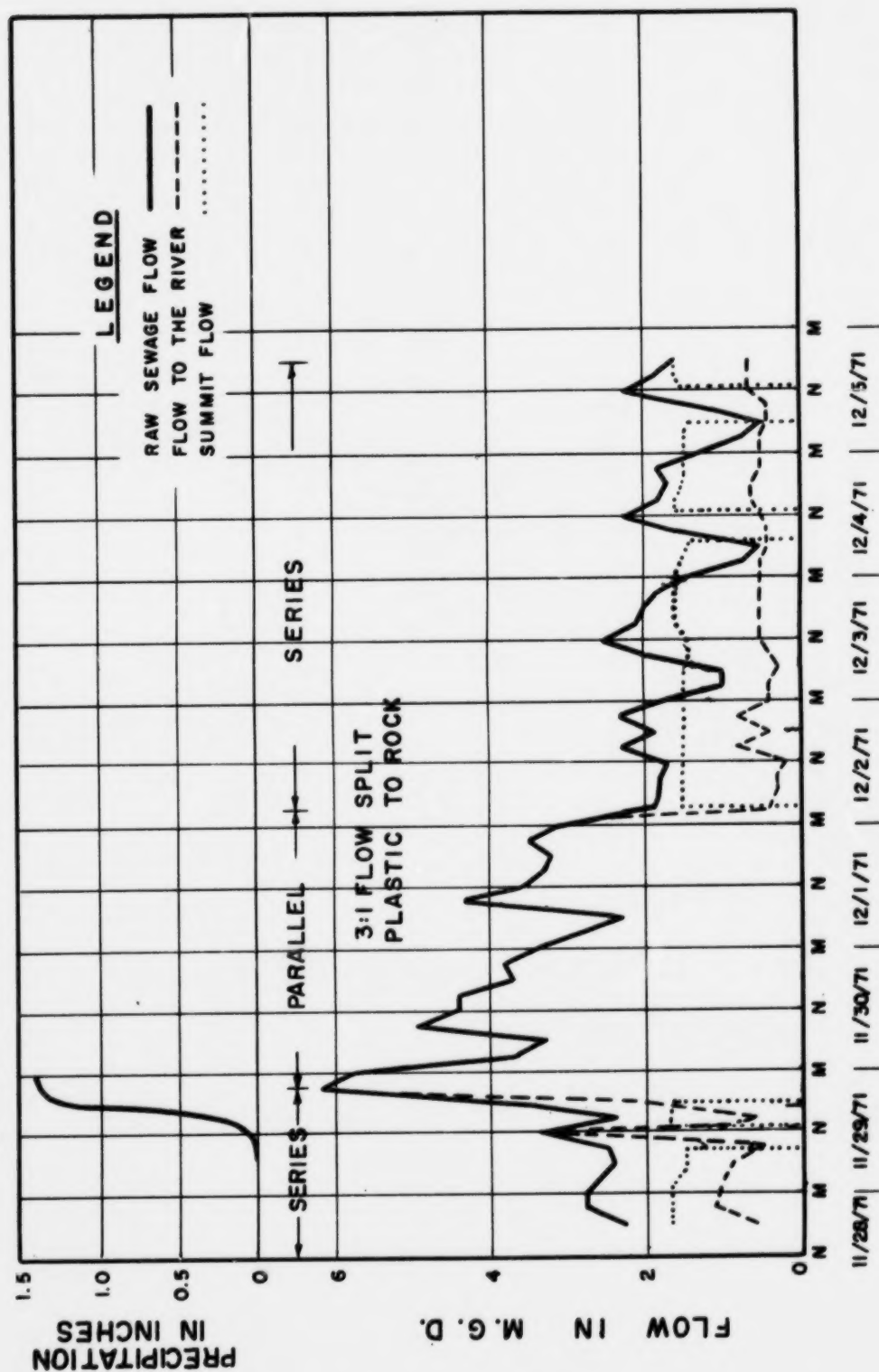


FIGURE 27
PRECIPITATION & PLANT FLOW VS. TIME

APPENDIX D
RESULTS OF SAMPLING
DURING 1972

TABLE 32

RESULTS OF SAMPLING BY PLANT PERSONNEL FOR JANUARY, 1972

<u>Date</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
1/12/72	0.63	146	148	7	22
1/13/72	2.00	168	203	8	12
1/19/72	0.63	189	217	17	13
1/27/72	1.51	215	449	16	33

TABLE 33RESULTS OF SAMPLING BY PLANT PERSONNEL FOR FEBRUARY, 1972

<u>Date</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
2/ 9/72	0.65	153	158	16	16
2/14/72	0.95	144	169	26	30
2/15/72	0.67	145	120	14	11
2/16/72	0.68	148	146	10	17
2/17/72	0.37	180	198	7	14
2/18/72	0.66	226	348	15	6
2/22/72	0.51	161	211	12	10
2/23/72	0.58	152	134	14	9
2/24/72	0.39	200	226	9	35
2/25/72	0.52	206	176	28	6
2/28/72	0.76	141	165	8	31
2/29/72	1.01	151	210	12	6

TABLE 34

RESULTS OF SAMPLING BY PLANT PERSONNEL FOR MARCH, 1972

<u>Date</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
3/ 1/72	3.11	142	93	14	24
3/ 2/72	3.43	161	132	21	18
3/ 3/72	4.39	79	166	22	42
3/ 6/72	0.77	137	152	12	20
3/ 7/72	0.59	153	179	8	7
3/ 8/72	0.59	128	153	5	14
3/ 9/72	0.68	134	153	5	11
3/10/72	0.44	119	97	3	13
3/13/72	0.55	126	91	5	11
3/14/72	0.42	140	135	5	13
3/15/72	0.82	117	131	4	23
3/16/72	4.87	170	159	5	17
3/17/72	4.58	76	58	33	38
3/20/72	0.86	167	136	6	15
3/21/72	0.66	165	173	17	5
3/22/72	0.87	150	114	15	18
3/23/72	1.13	104	141	3	10
3/24/72	0.56	108	112	6	4
3/27/72	0.52	228	227	5	8
3/28/72	0.44	186	175	11	6
3/29/72	0.44	109	85	4	7
3/30/72	0.49	175	124	6	12

TABLE 35

RESULTS OF SAMPLING BY PLANT PERSONNEL FOR APRIL, 1972

Date	Flow to River (MGD)	Raw Sewage		Final Effluent	
		BOD (mg/l)	Suspended Solids (mg/l)	BOD (mg/l)	Suspended Solids (mg/l)
4/ 3/72	1.53	130	214	11	3
4/ 4/72	1.64	164	107	18	18
4/ 5/72	1.74	225	109	31	31
4/ 6/72	1.48	121	110	10	10
4/ 7/72	1.05	136	195	35	39
4/10/72	1.35	138	131	19	2
4/11/72	0.44	126	98	11	6
4/12/72	0.48	123	92	7	4
4/13/72	0.67	170	102	6	8
4/14/72	0.40	106	97	2	6
4/17/72	2.46	166	100	22	22
4/19/72	0.66	159	203	6	4
4/19/72	0.45	151	136	10	13
4/20/72	0.53	130	168	8	13
4/21/72	0.42	159	136	10	12
4/24/72	0.54	138	204	3	10
4/25/72	0.76	56	29	12	12
4/26/72	0.39	71	86	2	4
4/27/72	0.46	128	295	3	8
4/28/72	0.53	223	241	7	15

TABLE 36
RESULTS OF SAMPLING BY PLANT PERSONNEL FOR MAY, 1972

<u>Date</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
5/ 1/72	0.48	129	227	4	9
5/ 2/72	0.55	161	97	8	8
5/ 3/72	0.76	113	143	5	6
5/ 4/72	0.70	179	229	4	5
5/ 5/72	0.47	147	172	8	2
5/ 8/72	0.42	120	265	5	14
5/ 9/72	1.60	158	181	19	26
5/10/72	1.25	88	155	7	15
5/11/72	0.73	119	175	9	13
5/12/72	0.51	151	166	3	19
5/15/72	1.42	87	177	10	9
5/16/72	0.72	149	99	12	10
5/17/72	0.51	120	49	5	6
5/18/72	0.49	85	172	--	7
5/19/72	0.64	133	245	18	7
5/22/72	0.83	83	160	9	2
5/23/72	0.64	114	251	4	3
5/24/72	0.52	69	110	3	2
5/25/72	0.51	103	200	3	17
5/26/72	0.48	112	99	4	23
5/30/72	0.45	106	208	7	9
5/31/72	0.65	94	226	5	6

TABLE 37
RESULTS OF SAMPLING BY PLANT PERSONNEL FOR JUNE, 1972

<u>DATE</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
6/ 1/72	0.50	157	132	7	6
6/ 2/72	0.52	88	124	3	5
6/ 5/72	0.45	122	125	4	9
6/ 6/72	0.42	123	183	3	9
6/ 7/72	0.47	122	239	4	10
6/ 8/72	0.40	175	234	6	7
6/ 9/72	0.60	120	158	11	20
6/12/72	0.72	123	181	6	6
6/13/72	0.39	117	153	6	2
6/15/72	0.55	242	152	16	9
6/16/72	0.50	101	63	8	7
6/19/72	1.59	74	30	20	12
6/20/72	0.60	156	315	14	9
6/21/72	1.49	—	—	15	14
6/22/72	3.98	93	144	10	6
6/23/72	3.08	53	141	10	15
6/26/72	2.06	180	177	41	14
6/27/72	1.08	205	126	18	9
6/28/72	1.25	115	189	23	38
6/29/72	0.53	90	78	9	12
6/30/72	0.53	110	101	8	5

TABLE 38
RESULTS OF SAMPLING BY PLANT PERSONNEL FOR JULY, 1972

<u>Date</u>	<u>Flow to River (MGD)</u>	<u>Raw Sewage</u>		<u>Final Effluent</u>	
		<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>	<u>BOD (mg/l)</u>	<u>Suspended Solids (mg/l)</u>
7/ 3/72	0.43	99	73	3	12
7/ 4/72	0.35	283	118	7	9
7/ 5/72	0.43	259	171	5	31
7/ 6/72	0.37	112	135	6	14
7/ 7/72	0.39	-	127	17	52
7/11/72	0.94	131	114	13	22
7/14/72	0.37	-	-	15	17
7/17/72	0.56	120	100	14	14
7/18/72	0.53	232	168	16	17
7/19/72	0.47	207	207	5	4
7/20/72	0.83	112	87	12	7
7/21/72	0.40	186	92	14	8
7/24/72	0.61	150	226	11	28
7/25/72	0.45	139	114	7	17
7/26/72	0.60	152	201	7	23
7/27/72	0.45	233	146	8	6
7/28/72	0.41	162	116	12	6
7/31/72	0.56	163	78	10	11

TABLE NO. 39
RESULTS OF SAMPLING AND ANALYSIS OF STORM NO. 7

Mode Of Operation: Parallel
Time Period of Parallel Operation: 9 AM on 11/14/72-5 AM on 11/15/72 Duration: From 1 AM on 11/14/72
To 1 AM on 11/15/72
Average Precipitation: 1.90 Inches
Time Period of Sampling: 8 AM on 11/14/72-8 AM on 11/15/72
Average Raw Sewage Flow: 4.63 MGD
Average Sewage Flow to Summit: 1.28 MGD
Average Flow Through Plant to Passaic River: 3.28 MGD
Average Flow to Filters (As Shown in Table)
Nature of Sample: Compositied on Dates and Over Time Period Shown

Date & Time	Flow (MGD)		PH				Suspended Solids (MG/L)				BOD (MG/L)			
	Rock	Plastic	PE	PF	RF	FE	PE	PF	RF	FE	PE	PF	RF	FE
11/14/72-11/15/72 (8 AM - 8 AM)	1.55	1.73	7.3	7.2	7.2	7.5	64	96	40	21	58	17	22	23

Date & Time	NH ₃ -N (MG/L)				NO ₂ -N (MG/L)				NO ₃ -N (MG/L)				Total-P (MG/L)				
	PE	PF	RF	FE	PE	PF	RF	FE	PE	PF	RF	FE	PE	PF	RF	FE	
11/14/72-11/15/72 (8 AM - 8 AM)	5.0	4.5	4.5	7.5	4.5	0.10	0.24	0.26	0.23	0.30	0.54	0.85	1.1	3.7	5.0	4.5	5.0

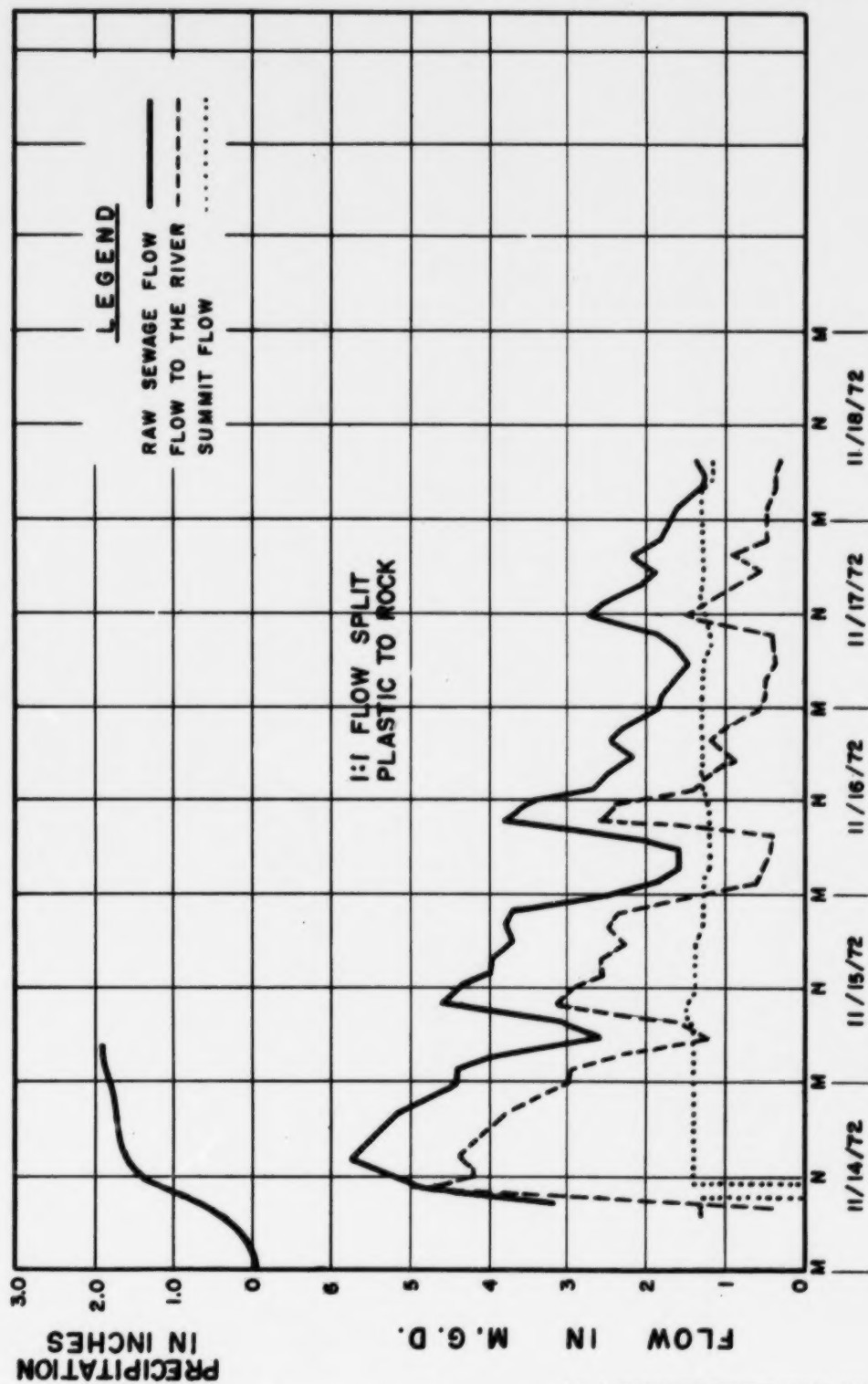


FIGURE 28
PRECIPITATION & PLANT FLOW VS. TIME